# CHINA'S OUTWARD INFRASTRUCTURE INVESTMENT IN AFRICA

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## Abstract

This thesis explores China's outward infrastructure investments in Africa through the lens of Frischmann's infrastructure theory, emphasising the role of infrastructure resources in generating economic value via positive externalities. Hence, the study evaluates the impacts of these investments across three key areas. First, it assesses how interactions between African firms and Chinese investors influence the performance of firms listed on African stock exchanges. Utilizing the Heckman two-stage selection model and the Average Treatment Effect analysis, the study reveals that while productivity spillovers are not always evident, these interactions significantly boost local firms' stock market valuations due to the signaling effect. Second, we examine the impact of these investments on the export activities of African nations, using a comprehensive industrial-level database covering fifty-four African countries. Employing the Heckman model and the Generalized Method of Moments, the results confirm an enhancement in export activities, particularly highlighting how Chinese state-owned enterprises' investments are driven by resource-seeking in primary industries and market-seeking in non-primary sectors. Third, we explore the influence of these infrastructure investments on African government borrowing, using Heckman's model and a machine learning algorithm to analyse potential debt-trap scenarios. Contrary to the prevalent debt-trap concerns, the study finds no evidence supporting this paradigm; instead, it suggests that commodity-based interactions might reduce Africa's debt burden. Overall, this comprehensive study contributes new insights into the dynamics of international infrastructure investments and their varied implications for African economic development.

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# CHAPTER 1
# INTRODUCTION

## 1.1 Motivation

Infrastructure investment has been a policy priority for developing and emerging economies, especially in response to the United Nations' Sustainable Development Goals (SDGs). The crucial role of infrastructure development in achieving these goals is highlighted, as it plays a foundational role in stimulating economic activity and growth (Markard, 2011). The African continent, in particular, faces distinct challenges, with infrastructure deficits significantly impeding economic progress. Critical challenges include energy access, road and rail transportation, and water infrastructure (Lakmeeharan et al., 2020; Alves, 2019). For instance, about 600 million individuals in sub-Saharan Africa experience energy poverty, representing more than two-thirds of the worldwide population without power (Alves, 2019). More so, Africa trails behind the BRIC (Brazil, Russia, India, and China) countries in key infrastructure measures such as rail density and road density (Lakmeeharan et al., 2020). These infrastructure deficits result in higher business costs, diminishing firm productivity, and impeding overall economic activities. Consequently, the continent faces severe gaps, as Africa contributes only 2% to global economic activities despite having 14% of the world's population (Usman & Landry, 2021).

The significant hurdles in obtaining funding for essential infrastructure projects like roads, bridges, and railways contribute to the continent's infrastructure deficit (Edinger & Jean, 2019). Bridging this gap necessitates increasing infrastructure investment as a percentage of GDP from the longstanding average of 3.5% to 4.5% (Lakmeeharan et al., 2020). The critical role of external financing becomes evident as

many African governments face rising debt levels, limiting their spending on infrastructure. Foreign investments are essential for economic growth and fostering innovation by providing opportunities for companies to introduce new products and services (Ciborowski & Skrodzka, 2020; Germaschewski, 2016).

Despite considerable development assistance from traditional donors, like the United States, the United Kingdom, the European Union, the World Bank, International Monetary Fund, Africa still faces a significant infrastructure deficit. In the early 2000s, China emerged as a prominent external financier for the continent. The China Global Investments Tracker (2021) reports that China's OII in Africa has escalated to over $267.87 billion, positioning China as the continent's primary source of infrastructure finance (see Figure 2 in the appendix). Further analysis by Deloitte (2021) reveals that Chinese infrastructure investment accounts for 10.6% of the total infrastructure investment in Africa, which amounts to $521 billion. This figure surpasses the combined investments from traditional investors such as the United States, European Union, United Kingdom, Australia, Brazil, Russia, and Canada, who collectively account for only 7.7% of the total investment (Deloitte, 2021).

In addition, Chinese outward foreign direct investment (OFDI) has experienced a meteoric rise, multiplying eighty-five times from less than $500 million in 2003 to $43 billion in 2017(Guillon & Mathonnat, 2019; UNCTAD, 2019). This establishes China as the largest source of external funding in Africa. While there is an extensive array of systematic studies exploring China-Africa engagement through OFDI, notable among them are works by Mlambo et al. (2018), Doku, Akuma & Owusu-Afriyie (2017), Odoom (2017), and Amighini, Rabellotti & Sanfilippo (2013), comprehensive analyses explicitly focusing on China's OII in Africa remain sparse. This underscores the need

for a more focused investigation into the scope and impact of China's infrastructure investments in Africa, which is the primary focus of this thesis.

Consequently, we draw on Frischmann's infrastructure theory, which emphasises the significance of infrastructure resources in creating value for society through positive externalities (Frischmann, 2005a, 2005b). Therefore, infrastructure resources such as transportation, energy, and water, among others, can improve the activities of individuals, companies, and the economy. Thus, the implications for resources from such positive externalities include, but are not limited to, technology transfers, knowledge transfers, an increase in trade activities, job opportunities for the locals, improved revenue bases for the host country, and eventually increased economic growth (Frischmann, 2012; Chen, 2021; Konstandina & Gachino, 2020). Thus, China's OII is crucial for bridging the gap and African activity. Interestingly, China-Africa cooperation has resulted in many infrastructure projects, such as the Abuja-Kaduna Railway, the African Union Headquarters in Ethiopia, the Ghana Bauxite Exploration, and the Congo Special Economic Zone (China Global Investment Tracker, 2021). These infrastructures are critical to African business and industry (Busse et al., 2016). The World Bank (2017) also highlights the potential for consistent annual growth of 1.7% in Africa if the infrastructure deficit is addressed.

China's OII represents a significant development for Africa due to its unique impact on local firms, industries, and government operations (Yeung & Liu, 2008). This investment strategy is characterized by the Chinese government providing bilateral infrastructure finance to African nations through its state-owned enterprises (SOEs), often concessional loans. These loans typically entail lower interest rates and extended repayment terms, sometimes including resource financing options (Du, 2016). Such

financial arrangements enable African governments to access critical infrastructure development funds without the burden of substantial debt.

Moreover, Chinese firms involved in these projects often prioritize using local labour and materials, bolsters job creation and supports local economies (Asayehgn, 2009). This practice contrasts sharply with general outward foreign direct investment (OFDI) and China's own OFDI, where many investors are private enterprises driven primarily by profit motives. In the case of China's OII, however, the selection of project contractors and procurement processes is usually managed by Chinese SOEs with goals extending beyond mere profit maximization, including fostering collaborations with local firms (Liu et al., 2020).

The strategic role of Chinese SOEs in Africa's infrastructure landscape is substantial; reports indicate that SOEs accounted for 31% of all infrastructure projects on the continent in 2019, a significant increase from 12% in 2013. In comparison, the share of Western firms decreased to 12% in 2019 from 37% in 2013 (Deloitte, 2013). The engagement of Chinese SOEs in Africa facilitates direct financial and technical support and extends to labour training, enhancing both the efficiency and skill levels within local workforces (Du, 2016). Thus, the multifaceted contributions of Chinese OII through SOEs underscore a profound and growing influence on Africa's socio-economic development.

To the researcher's knowledge, this paper is the first to utilise an experimental approach to explore the impacts of China's Outward Infrastructure Investment (OII) in Africa. While a plethora of studies on this phenomenon exists, they predominantly use observational methods, yielding a diverse array of findings. These studies offer varied perspectives: some underscore the positive outcomes, such as the development of

essential infrastructure, while others emphasise challenges related to local participation, resource exploitation, and debt sustainability, thus presenting a nuanced view of these engagements (Chen, 2021; Akin, 2017; Klaver & Trebilcock, 2011; Morrissey, 2012). For instance, Morrissey (2012) points out that most Chinese investments in sub-Saharan Africa focus on building infrastructure. He notes that Chinese companies often import their machinery, equipment, and workforce for these projects, resulting in minimal economic linkages and negligible spillover benefits for the region. Akin (2017) emphasised the need for sustainable practices in Chinese investments, considering environmental, labour, and debt-related challenges. Klaver and Trebilcock (2011) and Asayehgn (2009) delved into the motivations behind Chinese investment in Africa, suggesting a dual aim of securing market access in Africa and the West while also seeking efficiency and market opportunities for Chinese enterprises in local production processes. Taylor (2006) offered a critical view, suggesting that despite Africa's infrastructural gains, these investments predominantly aim at extracting raw materials, especially oil. Asayehgn (2009) observed in Ethiopia indicate some level of engagement with local suppliers, creating backward linkages. However, Klaver and Trebilcock (2011) and Adisu and Sharkey (2010) noted that the transfer of technology, skills, and labour benefits from China's investments are negligible.

The divergent perspectives in existing literature largely stem from the observational nature of previous studies, which are inherently prone to observer bias and other confounding factors that could obscure the actual effects of the phenomena under study. This has led to a significant gap in our comprehensive understanding of the impacts of China's Outward Infrastructure Investment (OII) in Africa. This research addresses this gap by employing an experimental method to minimise bias and

confounding effects, thereby offering a more accurate assessment of issues related to local participation, resource exploitation, and debt sustainability within China's OII in Africa. Through this approach, the study seeks to provide a clearer, evidence-based view of the complex dynamics of China-Africa infrastructure investments, contributing to a more nuanced debate on their implications for African development.

This study addresses three crucial questions in light of these various viewpoints. The first research question explores the impact of interactions between African-listed firms and Chinese SOEs through infrastructure projects, focusing on potential spillover effects on firm performance. While some scholars, such as Haroz (2011) and Khodeir (2016), view these interactions as beneficial, leading to productivity gains through technology transfer and improved infrastructure, others, including Klaver and Trebilcock (2011) and Corkin (2012), raise concerns about the limited technology and skill spillovers due to the location-specific nature of these investments and the predominant use of Chinese nationals in critical positions. This ongoing debate underscores the need for empirical research to truly understand the impact of these investments on the performance of African firms, particularly given the prevailing reliance on observational studies and the scarcity of econometric analysis. Our study seeks to address this gap by assessing how these interactions, facilitated by Chinese infrastructure projects in Africa, influence the performance of the involved African firms, thus providing insights into the signaling effect and the actual impact on listed firms.

The second research question focuses on the motives behind China's Overseas Infrastructure Investments (OII) in Africa and their effects on African exports amid discussions on whether China's engagements are primarily for resource-seeking or

market-seeking purposes. This inquiry is vital for African countries to navigate economic and trade relations strategically. Observational studies on OII, such as those by Klaver and Trebilcock (2011), hint that China's investment is a blend of motives, including market access in Africa and beyond. Asayehgn (2009) points to efficiency and market opportunities as motives of Chinese investors in Ethiopia, distinct from purely export-oriented ambitions. Taylor (2006) views China's investment, particularly in sectors like oil, as simultaneously meeting Africa's infrastructure needs and fulfilling China's resource acquisition strategies. Conversely, scholars such as Witness (2011) and Zhang et al. (2013) argue that China's OII serves dual purposes: securing resources and establishing a market presence. This dual approach could impact African export dynamics, particularly in the resource sector, and potentially displace local markets in the construction and other industries. Despite the robust discussion surrounding these phenomena, empirical evidence remains limited. This study aims to address this issue by empirically assessing the motives behind Chinese SOEs' OII and its effects on the export activities of African nations, thus providing a more nuanced understanding of the strategic implications of China-Africa economic engagements.

Thirdly, we seek to address concerns about African countries experiencing debt crisis due to Chinese infrastructure investment; it is imperative to assess the debt sustainability paradigm empirically. Amid contrasting views, with researchers like Were (2018) linking the surge in African government debt to Chinese investments through the resource-for-infrastructure model, and others such as Carmody (2020) and Gangte (2020) arguing that the perceived debt issues may instead reflect dependency or internal structural challenges rather than an actual trap, this study employs advanced data analysis and machine learning techniques to dissect the intricacies of China's OII and its

implications for debt sustainability. By aiming to offer comprehensive insights into how Chinese infrastructure projects influence African governments' debt levels, the research endeavours to guide policymakers and global stakeholders towards fostering more responsible and sustainable financial interactions with China, ensuring the fiscal stability and growth of African countries. This investigation aims to provide nuanced insights into whether China's OII contributes positively or negatively to African government debt. Addressing this question is essential for policymakers and international stakeholders to ensure responsible and sustainable financial engagements.

These three research questions collectively aim to comprehensively understand the multifaceted impact of China's OII in Africa. By employing this experimental approach, the study aims to clarify the complex interplay between China's infrastructure investments and Africa's economic landscape, contributing valuable empirical evidence to the discourse. In addition, our study could inform economic policy-related strategies for improving firm productivity and export activities while contributing to global efforts in managing debt. Then, we introduce the thesis's objective based on the dimensions of China's OII interaction channels.

## 1.2 Objectives

The thesis examines the effect of China's OII in Africa. It systematically assesses three key themes: firm interaction, exports, and the sustainability of African debt. This study explores whether such investment conforms to or differs from existing studies and popular perceptions. We focus first on analysing if African listed firms benefit from China's OIIinteraction via being a counterpart in infrastructure projects, having Chinese shareholders on their boards, and the presence of Chinese directors in their companies. We apply innovative methodologies, Heckman two-stage, average treatment effect, and

event study. We aim to test if Chinese SOEs and African firms' interactions via infrastructure projects affect the firms' stock market and accounting performance.

Moreover, whether the presence of Chinese shareholders or directors in the involved African listed firm can improve performance indicators. Second, we examine the motives behind China's OII on African exports. We divide China's OII interaction into being the recipient of OII, involved in the RFI model, and as a robustness project loan. This explores whether the motive behind these channels is resource or market-seeking. We utilize Heckman's two-stage model and the General Method of Moments (GMM) to address sample selection bias and endogeneity. Third, we assess the effect of China's OII on the debt sustainability of the African governments. Our focus lies in determining whether China's OII has the potential to result in a debt trap. We consider the different natures of theprojects, for example, resource and non-resource models, and use sophisticated machine learning tools to predict the debt trap paradigm. Overall, the abovementioned perspectives will help to understand the implications of the Sino-African engagement via infrastructure projects.

## 1.3 Contributions

This thesis contributes to the current international business on foreign investment in numerous ways. Firstly, in Chapter 3, we explore if African firms benefit from China-Africa's OII interaction. As far as current knowledge extends, no empirical substantiation exists regarding the effect of China's OII on the performance of African listed firms. We present novel evidence suggesting that interactions with these firms may not consistently yield productivity spillovers influenced by the absorptive capacity of the focal companies. Nonetheless, we propose that such interactions could enhance the stock market

valuation of local firms through a signaling effect. Our finding implies that China-Africa firms' interaction signals investors about the prospects of the involved local firms. Arguably, this strong signaling effect is a positive externality attributed to the Chinese government's supportin developing infrastructure projects in Africa. This effect boosts investors' confidence about the performance of the involved local firms. This thesis, therefore, contributes to existing knowledge on foreign investment by providing evidence of signaling effect and accentuating the significant role of government support in the context of China's OII.

Secondly, based on China's OFDI literature, chapter 4 is one of the few studies, but first for China's OII to analyse whether the motives of Chinese SOEs' interaction with their African counterparts via infrastructure projects affect African export activities. We uncover that the motives behind China's OII can complement or substitute African exports depending on the target industry. The resource-seeking motive holds for primary industries, while market-seeking is more pronounced for non-primary sectors. These imply that China's OII aims to serve the African markets and their home country's exports. This chapter's findings add to the current literature by accentuating that, like Chinese private investment, China's OIIin Africa is resource and market-seeking.

Thirdly, in Chapter 5, we address the methodological gap on China’s OII and debt trap paradigm. We apply Heckman's two-stage and a specialized machine learning algorithm to predict the debt-trap paradigm in Africa due to China's OII. Using the sophisticated tool to test the paradigm further improves the prediction accuracy of the traditional model. By filling the methodological gap in the debt trap paradigm, Heckman's two-stage. Hence, our study presents new empirical evidence suggesting no

debt-trap paradigm exists for China's OII in Africa. This evidence further accentuates the positive outcomes of globalisation theory.

## 1.4 Thesis Structure

This thesis has six chapters: an introduction, the background of the study, three empirical chapters, and a conclusion. Chapter one is the introduction, depicting the motivation, objective, contributions to knowledge, data and methods. Chapter two entails the research background, which provides an overview of China's OII interaction in Africa. It sheds light on the trajectory of Chinese-African relations., the mode of interactions, the roles of actors, and the role of FOCAC. Next isChapter Three, which is the first empirical chapter. It assesses the effect of China's OIIin Africa on the three firms' performance indicators (market value added, return on assets, and labour productivity). It also explores if the governance indicators could best explain the interaction and its effect on firm performance. We start the analysis by employing the Heckman-Two stage to assess our research objectives. The results suggest that Chinese SOEs' interaction with African-listed firms improves stock marketperformance but does not generate a productivity spill-over effect for African firms. As a check, we applied an event study to verify the signaling effect result obtained in our baseline results.

In conclusion, both estimation techniques support that the signaling effect is attributable to China's OII in Africa. Then, in chapter 4, we focus on the second empirical chapter. This section examines the motive behind Chinese SOEs OII on the exportsin Africa. It takes into consideration the differential effect of types of OII on exports. The results support the complementary and substitutability of the MNEs, and new trade theories hold for China-Africa firms' interaction via infrastructure projects. Invariably,

China's OII aims to serve both African export markets and the home country. The last empirical chapter is analyzed in Chapter Five. It investigates the impact of China's OII on debt sustainability in Africa. A specialized machine learning algorithm is utilised to predict the debt trap paradigm in Africa via Chinese infrastructure investment. We find support that China-Africa OII leans towards positive outcomes of globalization theory and, as such, would likely not cause a debt trap in Africa. The thesis is concluded in Chapter Six, which entails a summary of the main results, the policy implications, and the limitations of the study.

## 1.5 Data

The datasets utilized in this thesis are organized into three distinct categories. The first category includes data from the China Investment Global Tracker (CGIT) and the China-Africa Research Initiative (CARI), which provide detailed information about China's Outward Infrastructure Investment (OII). The second category comprises macroeconomic variables for African countries and industries, sourced from several databases, including the United Nations (UN) Comtrade, International Monetary Fund (IMF) Direction of Trade, World Development Indicators (WDI), and World Trade Organization (WTO). The third category entails financial, accounting, and governance data for African firms, which are collected from sources such as Thomson Reuters Datastream, audited annual reports, online reports, and the African Financials database.

For chapter three, which examines the impact of China's Outward Infrastructure Investment (OII) on the performance of African-listed firms, we gathered data on African companies interacting with Chinese state-owned enterprises (SOEs). This information was sourced from the China Investment Global Tracker (CGIT). We then matched these details with financial, accounting, and governance data obtained from

Thomson Reuters' DataStream, audited annual reports, and the African Financials database. This comprehensive dataset allows for a detailed analysis of the financial dynamics influenced by these cross-national interactions. This thesis covers the period of 2010–2021. In chapter four, we examine the motives behind China's OII on African exports. We sourced information on African countries and industries participating in China-Africa engagement from CGIT and CARI from 2005 to 2019. This is aligned with exports to China data from the World Trade Organisation (WTO) database. The macroeconomic variables, which are control variables, are obtained from datasets in the second category. Then, in chapter five, which focuses on evaluating the impact of China's Outward Infrastructure Investment (OII) on African government debt, we sourced data on China's OII from the China Investment Global Tracker (CGIT) and the China-Africa Research Initiative (CARI). Macroeconomic information was obtained from databases categorized under the second category. Additionally, data on debt sustainability were gathered from the World Development Indicators (WDI). This analysis encompasses the sample period from 2005 to 2019. All in all, the variables in all three empirical chapters have yearly observations.

## 1.6 Research Methodology

The primary estimation technique employed in this thesis is the Heckman two-stage model, developed by James Heckman. The Heckman two-stage approach is precisely estimated to solve sample selection bias and endogeneity problems that arise when researchers self-select samples into treatment groups (Heckman, 1978). This is divided into two stages: selection (first) and outcome (second). The selection equation predicts the likelihood of an individual being chosen into the treatment group, which is assessed utilising a probit model. In this stage, the potential bias produced by non-random

treatment assignments is mitigated (Heckman, 1978). In the second stage of the Heckman two-stage model, the treatment effect is estimated utilising the selected sample. This involves regressing the outcome variable on the treatment status and other relevant covariate variables using Ordinary Least Squares (OLS) regression. This method helps quantify the treatment's impact while controlling for potential confounders, thereby enhancing the accuracy of the analysis.

In our model, the decision for African firms to engage with Chinese investors in infrastructure projects (thereby receiving the treatment) is not random. This non-random selection is an important factor to consider as it influences the reliability and validity of the causal inferences drawn from the study. This justifies using this model to assess China's OII in Africa. This model allows for correcting the bias generated by selecting involved African actors (firms, industries, and countries) into the treatment group. It is assumed that the selection equation is correctly defined, and that no unobserved heterogeneity influencesthe selection process and the outcome (Heckman, 1978; Puhani, 2000). In addition, to ensure the robustness of the baseline model, the thesis employs several other analytical techniques. These include the Average Treatment Effect (ATE) model, Logistic Regression and the Generalized Method of Moments (GMM). These methods collectively enhance the reliability and validity of our findings by providing multiple lenses through which to examine the data.

Specifically, in Chapter 3, we apply Heckman's two-stage regression to assess the effect of China's OII on the performance of African-listed firms, addressing both sample selection bias and endogeneity in our data. We estimate the likelihood of firm interaction with Chinese investors and then correct this in the performance analysis, ensuring more accurate. In addition, we apply a similar model, the Average treatment

effect (ATE) model, as robustness for our baseline model. The model caters to the disparity in results observedbetween the group that received treatment and the one that did not. In contrast to the Heckman model, the ATE approach does not directly account for selection bias, instead prioritising estimating the treatment effect without considering the potential for the selection process (Heckman, 1978; Manning, 2004). However, this model estimation uses the full information maximum likelihood procedure because a bivariatenormal distribution is assumed between the error terms (Heckman, 1978). Both model estimations are used to examine the signaling and productivity spillover theories. Moreover, to substantiate the application of the signaling effect, we incorporate an event study methodology in our analysis. This approach is employed to capture the short-term reactions of the stock market to specific events related to China's Outward Infrastructure Investment (OII), providing insight into immediate investor responses.

In Chapter 4, we also examine the impact of China's OII on exports in Africa, utilizing Heckman's two-stage model to address potential biases arising from differences between African countries and industries that have received China's OII and those that have not. To verify our baseline model, we apply the Generalized Method of Moments (GMM) across the entire sample, addressing issues of endogeneity, heteroskedasticity, and reverse causality in our data (Arellano & Bover, 1995; Blundell & Bond, 1998). In Chapter 5, we also use the Heckman selection model to adjust for sample selection biases when assessing the effect of China's OII on African government debt. In addition, as a check on results obtained from the Heckman selection model. We utilize a specialized machine learning algorithm (logistic model). Naturally, logistic regression is frequently referred to as a regression model. However, it is a machine-learning classification algorithm that uses various optimization algorithms, including gradient descent

(Brownlee, 2016). The rationale for using this tool is that maximum likelihood estimation is utilized to estimatethe coefficients of our variable of interest, which are subsequently applied to the inputdata via the logistic function to generate predictions of the debt traps in Africa.

# CHAPTER 2
# BACKGROUND ON CHINA'S OUTWARD INFRASTRUCTURE INVESTMENT IN AFRICA

In this chapter, the study offers an overview of the China-Africa interaction to gain insights into this intricate relationship. The chapter is organised into five (5) sections. Section 2.1 examines China's involvement in Africa, specifically focusing on infrastructure projects and the intricate economic dynamics. Next, section 2.2 delves into the engagement context before and after FOCAC, while section 2.3 explores the roles of FOCAC in promoting engagement. The various forms of infrastructure cooperation can be found in Section 2.4. In Section 2.5, the roles of the actors in the interaction are also described.

## 2.1 Nature of China and Africa Engagement

China's involvement in Africa can be traced back to 1955, beginning with the Asian-African Conference held in Indonesia. During these early years, China focused its aid and investment primarily on agriculture and mining, establishing Egypt as an early key partner. During this period, the relationship between China and Africa included trade, foreign direct investment, and development finance assistance (Brautigam, 2009). Notably, the 1970s saw China assist in constructing the Tanzania-Zambia Railway, a project highlighting China's commitment to supporting Africa's infrastructure development (Brautigam, 2009; Alden, 2007). Although there was a decline in activity in the 1990s due to economic constraints on both sides, earlier initiatives like the Tanzania-Zambia Railway continued to play a crucial role in regional connectivity and trade.

The Forum on China-Africa Cooperation (FOCAC) establishment in 2000 marked a significant milestone in China-Africa relations, catalysing further development in infrastructure collaboration. Coinciding with the launch of China's "Go Global" strategy the same year, this initiative encouraged Chinese state-owned enterprises to expand into African markets, supported by government incentives such as subsidized loans and direct investments (Du, 2016; Sun, 2014). This policy push contributed to the proliferation of infrastructure projects throughout Africa, including constructing roads, railways, and special economic zones (SEZs). These developments have been instrumental in boosting economic growth and improving trade capacities within and between Africa and China (Brautigam & Xiaoyang, 2011).

During this period, the scale and significance of China's involvement in Africa's infrastructure development were underscored by several significant projects. For instance, the China Railway Construction Corporation invested $1.7 billion to rebuild Angola's rail network, and the China Road and Bridge Corporation secured a $211 million loan to finance road construction in Angola. These projects exemplify the substantial impact of Chinese engagement in the region (Jurenczyk, 2020; Hess & Aidoo, 2015). Additionally, the establishment of Special Economic Zones (SEZs) by Chinese firms across various African nations has significantly boosted local industries ranging from construction materials to logistics and transportation, depicting the depth of China's investment in fostering Africa's economic growth (Brautigam & Xiaoyang, 2011).

Chinese private investment in Africa has played a substantial role, extending beyond infrastructure to sectors like telecommunications and manufacturing (Sun, 2014). This broadening scope is primarily fuelled by Africa’s abundant natural

resources, competitive labour costs, and a burgeoning consumer market, attracting numerous Chinese private investors (Kaplinsky & Morris, 2009). Although these investments have created jobs and boosted economic growth across the continent, they have also sparked concerns about their sustainability and the potential adverse effects on local industries and environmental health (Kaplinsky & Morris, 2009; Sun, 2014).

In terms of trade, the relationship between China and Africa has seen remarkable growth, with China emerging as one of Africa's largest trading partners. This burgeoning trade relationship, driven by China's appetite for African natural resources and Africa's reliance on Chinese manufactured goods, plays a crucial role in Africa's efforts towards economic diversification and industrialization (Carmody & Owusu, 2007). However, the trade imbalance in favour of China highlights the need for a more equitable and sustainable partnership that ensures mutual benefits and supports Africa's long-term development goals (Broadman, 2006; Carmody & Owusu, 2007).

The multi-dimensional relationship between China and Africa, spanning infrastructure investment, private investment, and trade, offers both opportunities and challenges. While the partnership has contributed to infrastructure development in Africa, addressing concerns related to sustainability, equity, and the impact on local communities is essential for realizing the full potential of this relationship. Future engagements should aim for balanced growth, emphasizing sustainable development and mutual benefits to foster a resilient and equitable China-Africa partnership.

### 2.1.1 Chinese Private Investment in Africa

The involvement of Chinese private investment in Africa extends across diverse sectors such as mining, agriculture, manufacturing, and services. Unlike state-driven

investments, which often focus on infrastructure and energy, private Chinese investments tend to be more diverse, targeting opportunities that promise prompt returns and less political risk (Cheung et al., 2012; Deng, 2009). According to Sun (2017), private Chinese investors are particularly drawn to sectors such as retail, manufacturing, and small-scale infrastructure projects, where they can leverage their competitive advantage in low-cost manufacturing and business operations. This diversification of investment types showcases the evolving nature of Chinese economic interaction with Africa, reflecting both the broadening interests of China's private sector entities and the increasing openness of African economies to foreign direct investment (FDI).

Chinese private investors' strategic approach in Africa is notably shaped by the Belt and Road Initiative (BRI), a comprehensive global development strategy adopted by the Chinese government (Sun, 2017). While the BRI primarily involves state-owned enterprises (SOEs) in large-scale infrastructure projects, it also creates a conducive environment for private investments by improving connectivity and reducing operational risks (Alden, 2007; Ajakaiye & Kaplinsky, 2009). Githaiga et al., (2019) argue that the enhanced infrastructure and trade links facilitated by the BRI have lowered entry barriers for private Chinese investors, enabling them to explore new markets and opportunities in Africa. This synergy between China's state-led initiatives and private sector ambitions exemplifies a coordinated effort to deepen China-Africa economic ties, with a growing emphasis on the private sector's involvement (Cheung et al., 2012).

Notably, China's private investment approach in Africa strongly emphasises local partnerships and capacity building (Chen et al., 2018). Unlike earlier waves of foreign investment in the continent, which were often criticised for their extractive nature, Chinese private investments frequently involve joint ventures with local firms

and investments in local human resources (Chen et al., 2018). Rotberg (2009) highlights the growing trend of Chinese companies investing in training programs and technology transfer initiatives in Africa, aiming to foster a more sustainable and mutually beneficial economic relationship. These efforts not only contribute to the local economy by creating jobs and enhancing skills among the workforce but also help Chinese investors to navigate the complex socio-economic landscape of African countries more effectively (Buckley et al., 2009; Dreher & Fuchs, 2011).

However, the increasing footprint of Chinese FDI in Africa has also raised concerns regarding governance, labour standards, and environmental sustainability (Zhang et al., 2013; Drogendijk and Blomkvist, 2013). Critics argue that in their pursuit of profitability, some Chinese private investors may overlook local regulations and international best practices, potentially leading to adverse social and environmental impacts (Ayodele & Sotola, 2014; Davies, 2016). Zhang et al., (2013) caution that without proper oversight and adherence to responsible business practices, the long-term sustainability of Chinese private investments in Africa could be compromised. Hence, it is imperative for Chinese investors and African host nations to collaborate closely to ensure that investments align with sustainable development objectives, thereby ensuring broad-based benefits and fostering the continent's growth. From this viewpoint, it becomes evident that China's private investment in Africa is a multifaceted and evolving dynamic, offering opportunities for economic advancement and development alongside challenges that necessitate industrious management and cooperation among Chinese investors, African governments, and global stakeholders.

### 2.1.2 Trade Relations between China and Africa

The trade dynamics between China and Africa have evolved significantly over the

decades, growing from a relatively modest beginning to become one of the most critical economic partnerships in the global South. This relationship has witnessed a rapid surge in trade volumes, leading to China overtaking the United States as Africa's primary trading partner in 2009. This transition was spurred by China's "Going Out" policy in the early 2000s, encouraging Chinese businesses to expand overseas, combined with Africa's abundant natural resources and infrastructure development needs (Sun, 2014; Carmody, 2016). Moreover, the trade dynamics have been bolstered by the Forum on China-Africa Cooperation (FOCAC) in 2000, which convened triennial summits to deepen economic ties between China and Africa.

The trade relationship between China and Africa has typically been asymmetrical, with African nations primarily exporting raw materials like oil, minerals, and timber while importing manufactured goods, machinery, and electronics from China (Zafar, 2007). This trade pattern has raised concerns about a new form of dependency, echoing historical patterns of trade that benefitted colonial powers at the expense of African economies (Mohan & Lampert, 2013). The trade imbalance has been notable, resulting in numerous African nations facing substantial trade deficits with China. While this has contributed to economic growth and infrastructure advancement across various African countries, it has also raised concerns regarding the sustainability of this trade framework and its impacts on industrialization and economic diversification in Africa (Brautigam, 2009).

Efforts to tackle the trade disparity have involved both China and African nations exploring avenues to bolster Africa's capability for value addition and broaden the spectrum of exports. Initiatives like the China-Africa Industrial Capacity Cooperation Fund, set up to foster industrialization in Africa, and the escalating Chinese

investments in Africa's manufacturing sector strive to steer trade patterns towards more equitable and sustainable development results (Sun, 2014). Moreover, there is a growing emphasis on enhancing Africa's export competitiveness through technology transfer and skill development programs. As this relationship continues to evolve, it remains crucial for both China and Africa to foster trade dynamics that are equitable, sustainable, and conducive to long-term development goals (Alden et al., 2008; Brautigam, 2009).

The evolution of China-Africa trade relations underscores a complex interplay of economic opportunities and challenges. While the partnership has undoubtedly spurred significant infrastructure development and economic progress in Africa, the persisting trade imbalance and the composition of traded goods underscore underlying issues that need to be addressed. For African countries, the goal is to leverage this relationship to catalyze a more diversified economic structure that reduces dependency on raw material exports. For China, addressing these concerns is also crucial to sustaining its relationship with Africa and maintaining its image as a responsible global leader. Future directions in China-Africa trade relations will likely hinge on how both sides navigate these challenges, with an increasing emphasis on sustainability, equity, and mutual benefit (Alden et al., 2018; Sun, 2020).

### 2.1.3 Infrastructure Activity in Africa and its Economic Complexities

The growing involvement of emerging investors in financing infrastructure projects in Africa signifies an important shift in the dynamics of international development and economic influence on the continent. Traditionally, infrastructure financing in Africa has relied heavily on Official Development Assistance (ODA) from OECD countries and investments from large private sector players from the West. However, the emergence of new players, particularly from countries like the Gulf states, India and China, has

diversified the funding sources and could potentially lead to different outcomes regarding development priorities, project execution, and regional influence. Among these new players, China stands out as the most significant contributor in terms of investment size. Deloitte (2021) reports that Chinese infrastructure investment in Africa accounted for 10.6% of the total infrastructure investment ($521 billion). This figure surpasses the combined contribution of traditional donors (including Canada, Australia, Brazil, United States, Russia, European Union, and United Kingdom), which amounted to 7.7%. While the African government contributes significantly with 31.4%of the financing, it is noteworthy that China emerges as the primary financier and developer of infrastructure projects in Africa compared to other nations (see Figure 1in the appendix).

Over the past two decades, China's involvement in developing infrastructure in Africa has experienced a notable rise. This engagement is influenced by various factors, including social, environmental, and economic considerations, which have significantly influenced the nature and results of these projects. These considerations have had varied effects on both parties. China's approach to financing infrastructure in Africa contrasts with that of Western donors, as it mainly provides development assistance via soft loans instead of grants (Du, 2016). These loans are mainly facilitated by the China Export-Import (Ex-Im) Bank, which offers somewhat favourable terms. These terms include favourable conditions such as low-interest rates, prolonged repayment periods, and no conditionalities. The "no-strings-attached" approach to assistance has garnered interest from certain African countries due to its provision of greater freedom in contrast to the conditionalities imposed by conventional Western investors. More so, the financing often involves using natural resources as repayment, known as the "Angola model," which has contributed to the increase in China's infrastructure investments in Africa due

to its no-strings-attached approach. (Corkin, 2014).

Notably, China has become a major investor in African infrastructure, and Africa is, in turn, the primary beneficiary of China's OII on a global scale. According to the CGIT (2021) database, China's OII in Africa amounted to $267.87billion between 2005 and 2021. This figure represents around 31% of Chinese's OII in the world ($859.62 billion). This figure positions Africa as the leading recipient of China's OII, surpassing other regions (see Figure 3 in the appendix). Moreover, a substantial portion of the total amount is allocated to the sub-Saharan region, with $212.98 billion directed towards this area. At the same time, the North African region receives a noteworthy amount of $54.98 billion (see Figure 3 in the appendix). Accordingly, the most significant deals have occurred in Nigeria, Algeria, Angola, and Ethiopia, collectively accounting for 36% of the total. Regarding the allocation across sectors, it is observed that the energy, construction, and transport sectors are the primaryrecipients of infrastructure investment, accounting for 29%, 13%, and 35% of the overall investment, respectively. A significant proportion of the total investment,precisely 23%, has been allocated to the remaining sectors together. The investment patterns of the sectors exhibit a notable similarity throughout the regions of sub-Saharan Africa and Northern Africa (see Figure 2.3 in the appendix).

#### 2.1.3.1 Economic Complexities

The expanding ties between China and Africa across various regions and sectors can be understood by analysing the economic dynamics that emerge from their interaction. First, the main issue many areas worldwide face, particularly in Africa and South Asia, is a significant infrastructure deficit. This deficit is characterised by substantial investment requirements and an accompanying shortfall in funds (see Figure 4 in the

appendix). Therefore, Governments must augment their investments in infrastructure to bridge the infrastructure gap. Due to theprevailing fiscal restrictions faced by several African nations, the prospect of government investment is frequently challenging. In Africa, it is a prevalent practice for governments to depend on external sources of financing to fulfill their infrastructurefunding requirements. Countries obtain loans from several sources, including international institutions, foreign governments, and commercial lenders. According to dependency theory, reliance on external financial resources can engender a detrimental cycle of indebtedness for developing nations (Aluko & Arowolo, 2010). The government incurs debt to fund development projects, yet the debt accumulation mightlead to an onerous burden. The excessive buildup of debt that exceeds a nation's abilityto repay can result in a debt crisis, significantly impacting the country's economy (Osakede & Adeleke, 2022). The increase in China's infrastructure development in Africa, including investments in traditional and RFI obligations, necessitates an evaluation of government indebtedness in African nations.

Second, inadequate infrastructure restricts the operations and economic advancement of industries in Africa, with significant deficiencies noted in the resource sector, particularly in power generation and household accessibility. Unstable power supplies result in industrial production losses equivalent to 6% of turnover (Foster et al., 2009). Moreover, the operational costs in Africa are generally higher than in other global regions. Notably, China's overseas infrastructure investments have predominantly targeted the energy sector. Consequently, improvements in this area are likely to spur economic growth. In Africa, China's approach to overseas infrastructure investment often involves a resource-for-infrastructure swap, whereby China funds infrastructure developments to access a country's natural resources. This method differs from the norm,

in which infrastructure investments are generally funded through traditional financing mechanisms like loans or foreign direct investment. These disparities have considerably impacted host nation exports and regional economic dynamics. In Sudan, for example, China Exim Bank made significant loans to fund the Merowe Dam Project, the Al Jaily gas-fired power plant, and a new railway connection to Port Sudan, among other projects. Some of these projects aid in extracting and exporting oil from Sudan (Bosshard, 2007).

Moreover, China has developed one of the world's largest and most competitive construction sectors, demonstrating remarkable expertise in essential civil engineering tasks necessary for infrastructure development. Chinese companies play a direct role in financing, engineering, and constructing African infrastructure projects, with a substantial portion of the workforce and materials being imported from China (Chen & Orr, 2019). While this approach can accelerate project completion, it might restrict the involvement of local contractors and suppliers, potentially reducing the recipient country's exports (Jauch, 2011). With the significant variations in the levels of China's overseas infrastructure investments across different African sectors, it is crucial to analyse their motivations. According to theories from multinationals and new trade, these motivations could be complementary or substitutable, influencing exports within the framework of China-Africa relations.

Third, the focal point of China-Africa infrastructure ties lies in partnerships and collaboration. Chinese enterprises frequently collaborate with African peers, particularly local firms, to undertake construction projects. The prevailing research in international business suggests that the engagement between local enterprises and their foreign counterparts typically leads to the transfer of productivity-enhancing knowledge

and practices to domestic firms. A prevalent phenomenon observed in African enterprises entails engagement in lobbying activities to secure participation in government contracts, particularly those of infrastructure projects. This service encompasses the provision of logistical, engineering, and construction services by local contractors. The establishment and sustenance of robust relationships hold significant importance within the context of African commercial practices. Culturing rapport, networking, and sustaining positive connections with stakeholders, including customers, suppliers, partners, and government officials, are widely acknowledged as crucial factors contributing to sustained success over an extended period. African enterprises encounter various obstacles, encompassing restricted financial accessibility and, most significantly, the inadequate commercial infrastructure needed for their activities. Numerous companies are strategically growing their operations by capitalizing on global networks to overcome limitations and access broader markets. Evaluating the economic advantages derived from the firms' relationship is imperative.

### 2.1.3.2 The Public Perceptions about the Economic Complexities

The involvement of China in Africa through infrastructure projects has generated discussions regarding the objectives and ramifications of its rising influence. The economic complexities of China-Africa infrastructure involvement have elicited favourable and unfavourable public sentiments. On a positive note, China'sinfrastructure projects in Africa have garnered favourable perceptions for their capacity to foster economic growth and development. According to Ofosu and Sarpong (2022), implementing infrastructure projects, including developing road networks, railway systems, port facilities, and energy infrastructure, can enhance connectivity, facilitate trade activities, and promote industrial growth. Consequently, these endeavours can

generate many employment prospects and yield substantial economic advantages. Tovar (2019) has documented that China's Belt and Road Initiative has significantly facilitated the transport of commodities, services, and individuals, particularly through the development of crucial rail projects like the Abuja-Kaduna Rail Line in Nigeria as well as the Addis Ababa-Djibouti Railway in Ethiopia and Djibouti. These case studies of railway systems demonstrate how China's OII enhances regional connectivity and economic integration. In a related analysis, Haroz (2011) explores Chinese investments in Africa, particularly the Angola case. The results suggest that these investments have beneficially influenced Africa's infrastructure development and promoted technology transfer.

Khodeir (2016) found that China's investments in 38 African countries resulted in better employment outcomes for local workers and enhanced technology transfers in sub-Saharan Africa than in northern Africa, indicating varying impacts of Chinese investments across the continent. Similarly, Dollar (2016) discussed how Chinese investments significantly boosted African employment, given its growing population and workforce. Africa has faced long-standing infrastructure challenges, and Chinese investments in infrastructure are seen as a way to mitigate these gaps. The development of essential infrastructure, such as power plants, water reservoirs, and telecommunications networks, is often considered vital to improving living standards, increasing access to services, and promoting overall development in Africa (Mlambo et al., 2016; Ofosu & Sarpong, 2022).

Nevertheless, it is essential to acknowledge the drawbacks associated with Chinese infrastructure projects in Africa, particularly the restricted utilization of local workers and resources. According to Klaver and Trebilcock (2011), it is observed that

these projects did not produce adequate employment opportunities and foster the growth of local enterprises and industries. More so, Jauch (2011) has established that certain Chinese state-owned enterprises (SOEs) procure the necessary materials and personnel for African construction projects from their home country. The action has thepotential to impede the dissemination of skills and technology to African enterprises. Furthermore, the issue of debt and financial dependency has raised significant apprehension concerning China's infrastructure projects in Africa. According to Were (2018), critics have made assertions regarding the significant debt burdens that nationshave assumed to finance infrastructure projects. Critics argue that high debt levels could challenge debt repayment and risk the loss of sovereignty or control over essential assets in cases of default. The public perception of China's infrastructure initiatives includes concerns about resource utilisation and economic impact. Issues such as resource exploitation, environmental degradation, community displacement, and neglect of social and labour standards during project implementation have been highlighted (Taylor, 2006; Ayodele & Sotola, 2014; Davies, 2016).

Overall, the China-Africa partnership, via infrastructure projects, holds significant importance for the development of Africa. The following section will detail China's involvement in Africa before and after FOCAC.

## 2.2 China's Engagement in Africa before and after FOCAC

The consequences of the early Cold War resulted in significant harm to Africa, including the loss of millions of lives and hindering regional integration and economic progress. The conflicts during this period reduced economic growth by approximately 2.5 percent on average in the affected nations (Fang, et al., 2020). During the Cold War, China primarily engaged with Africa by assisting and supporting various African liberation

movements. China's involvement in Africa's infrastructure development has consisted of several small to moderate projects designed to mitigate the effects of the Cold War period and stimulate economic progress. Nonetheless, the magnitude of involvement in infrastructure projects have expanded since the formation of FOCAC. The platform has aided the China-Africa parties in developing bilateral strategic cooperation alliances and increased infrastructure project support through institutionalized aid and resources for infrastructure models (Zhang, 2014; Vhumbunu, 2017; Jurenczyk, 2020). For example, using these strategies, China has helped fund the Angola war reconstruction project as well as built the Ethiopian railway station and the Kenya railway, among others. These projects have contributed to increased economic activity and connectivity throughout the region. Since then, FOCAC has had a profound impact on China-Africa infrastructure cooperation.

Another key difference is the typical method of financing used for these projects. Before the establishment of FOCAC, Chinese firms funded African infrastructure initiatives primarily through commercial loans, which often carried high interest rates and had short repayment periods. However, since the creation of FOCAC, the Chinese government has shifted towards offering more concessional loans and grants to African nations for their infrastructure projects. This shift has alleviated the financial strain on these countries, enabling more extensive infrastructure development. Additionally, before FOCAC, infrastructure development in Africa focused mainly on traditional sectors such as railways, power generation and road. Post-FOCAC, there has been a broadening of focus to include diverse fields such as finance, tourism, telecommunications, security, aviation, broadcasting, and television, marking a significant expansion in areas of cooperation.

A strengthened partnership is currently the most essential aspect of cooperation. China served as the critical impetus for China-African infrastructure cooperation before FOCAC was formed. However, after FOCAC, a more balanced relationship in infrastructure cooperation between China and African states has developed. Notably, African countries possess more significant influence in formulating and implementing infrastructure projects. China Global Investment Tracker (2022) highlights that the strengthened collaboration between China and Africa has led to the development of more than 500 projects in Africa that are crucial for economic activities. The role of the Forum in promoting cooperation between these two regions is highly significant. The details of FOCAC will be explored in the subsequent section.

## 2.3 The Forum on China-Africa Cooperation

The Forum on China-Africa Cooperation (FOCAC) is built on collaborative partnerships between China and 53 African nations, except Eswatini, due to its diplomatic relations with Taiwan. This forum convenes every three years, uniting governmental agencies and business executives from China and Africa. Compared to other African collaboration platforms, FOCAC has the most impressive strategic depth, breadth, and level of cooperation with a single external player (Mahmoud, 2010; Mthembu, 2021). In principle, the forum establishes a multilateral environment where all participating countries are considered equals. However, the formidable capabilities of the Chinese state require the establishment of 53 distinct bilateral relationships, each concentrated on a unified structure. This strategic framework facilitates economic activities, including trade growth, agricultural projects, technological progress, and the development of communication infrastructure (Mahmoud, 2010). For instance, during the 2018 FOCAC

summit, China committed $60 billion to 53 African nations, which included $10 billion for development financing, $20 billion in credit facilities, and $15 billion in grants and interest-free loans (Mthembu, 2021). These funds have facilitated the construction of essential infrastructure, including ports, railways, highways, and airports, enhancing connectivity between Africa and China. In addition, the funds have supported the growth of Chinese investments and trade in Africa, particularly within the manufacturing, agriculture, and energy industries. The Forum on China-Africa Cooperation fosters mutually advantageous collaboration between China and African nations. The development of infrastructure cooperation through FOCAC can be divided into three distinct stages.

The initial phase of FOCAC's engagement (2000-2006) focused on providing targeted funds to established Chinese companies to boost their investments in African nations, promote political cooperation, and foster a conducive environment for business and trade between China and Africa (Wu, 2020; Sanfilippo, 2010). A fundamental commitment during this period was the creation of the China-Africa Development Fund (CADfund), established by the China Development Bank with a $5 billion budget to support Chinese enterprises investing in Africa (Sanfilippo, 2010). Moreover, this phase saw the implementation of the "Angola Model" RFI in Africa, a strategy that enhanced China's economic relationships with African countries. This model facilitated China's access to energy resources, new markets, and investment opportunities (Carmody & Owusu, 2007). At the same time, African countries benefited from loans, earnings from raw material sales, and support in infrastructure development, exemplified by Angola's $2 billion oil-for-infrastructure deal (Asante & Debrah, 2017).

Moreover, the second phase of the Forum on China-Africa Cooperation

(FOCAC) from 2006 to 2015 focused on enhancing economic collaboration through technical support, training, and technology sharing between China and Africa. Launched in 2007, the China-Africa Development Fund (CADFund) has broadened Chinese investments across the continent. This fund primarily supports Chinese companies engaged in economic and trade activities in Africa, such as investing in local enterprises and initiatives. As of 2013, the CADFund has facilitated the development of over 80 African projects, amounting to $1.6 billion in investment. Notable projects include cement and glass factories in Ethiopia, a grain production initiative in Zambia, a food processing facility in Malawi, a container port in Nigeria, and a hydroelectric dam in Ghana (Jacks, 2013).

Since initiating China's Belt and Road Initiative (BRI) in 2013, the nation has played an increasingly prominent role in developing Africa's infrastructure. The BRI has focused on creating special economic zones, ports, critical transport networks and power grids (Wu, 2020; Madeira et al., 2023). A prime example is China's construction and financing of the Mombasa-Nairobi Standard Gauge Railway in Kenya. This project has dramatically enhanced Kenya's transport infrastructure, enabling quicker and more efficient transport of goods and people between these two major cities. Initially, the initiative emphasized physical infrastructure, but it recently focused on enhancing digital infrastructure (Adeniran et al., 2021).

China's infrastructure development in Africa has expanded to cover digital and technology areas during the third phase (2015–present) to include sectors critical for the continent's leap into the fourth industrial revolution. During this period, China has established submarine cable networks along the African coastlines, significantly enhancing the accessibility and speed of broadband across the region (Liow, 2021).

Moreover, China has constructed the first public cloud in Africa, and data storage solutions and software platforms have been designed for use by national governments (Calzati, 2022). China's technological contributions to Africa encompass both tangible and intangible elements. Specifically, in this third phase, China focuses on collaborative projects in space technology, including promoting the Beidou system, a global satellite navigation system comparable to Google's GPS, which supports satellite-based services across Africa. The World Economic Forum (2019) suggests that satellite data could generate annual economic benefits of $2 billion for Africa.

In contrast to Russia, which predominantly views African nations as clients for space launches, China has enhanced its space launch services and financing, enabling these nations to acquire their satellites (Yinka Adegoke, 2019). For instance, in 2019, China supported the launch of Ethiopia's first satellite, financing $6 billion of the total $8 billion spent on the project (Barisitz, 2020). As various countries prioritize space initiatives, China's support for Africa's space endeavours aligns with the continent's broader objectives.

Overall, the FOCAC phases have built a track record proving the creation of a comprehensive and mutually beneficial collaboration between Chinese and African. This interaction reflects a shared destiny and a strong commitment to furthering economic and social growth.

## 2.4 Infrastructure Cooperation between China and Africa

The formation of the FOCAC has underscored the significance of enhanced collaboration in infrastructure development between China and Africa. The initiative involves African and Chinese stakeholders working together to improve Africa's infrastructure. Various channels have facilitated this cooperation, including bilateral

agreements, multilateral initiatives, and Chinese investments in African infrastructure projects. The extant literature on private investment posits that external investment facilitates the introduction of novel technologies, expertise, financial resources, and employment prospects to recipient nations. To be more precise, it enhances capacity-building through research and development. This capacity-buildingprocess has resulted in beneficial outcomes for the project's direct stakeholders, the larger geographical area, and the nation as a whole. For instance, China and Kenya collaborated on the development of the Mombasa-Nairobi Standard Gauge Railway in Kenya. Here, Chinese companies provided the technology, equipment, and financing for the project. At the same time, Kenyan workers were employed to build and operate the railway. The railway has improved transportation within Kenya and facilitated the transfer of technical skills and knowledge. This cooperation has contributed to local capacity building, the development of a skilled workforce in Kenya,and improving connectivity in Africa.

The Belt and Road Initiative (BRI) cooperation continues to serve as the model for China-African collaboration regarding the integration of African nations and providing a transit network for economic integration (Adeniran et al., 2021). China's collaboration with Africa on infrastructure development spans several areas, such as the Belt and Road Initiative (BRI), communication systems, agriculture, energy and mineral sectors, healthcare, and education. The BRI projects in Africa facilitate regional connectivity and boost opportunities for cross-border trade (Madera et al., 2023). For example, the TAZARA Railway project connects Tanzania with the Central Province of Zambia in East Africa, as does the Nairobi- Mombasa high-speed line project.

China has enhanced Africa's agricultural self-sufficiency by creating numerous

agricultural demonstration centers across twenty African nations and sending agricultural specialists to train and advise local farmers (Li et al., 2022). These demonstration centres in Malawi, Zimbabwe, and Rwanda have successfully advanced farming techniques (Mapiye et al., 2021). China is also engaging African stakeholders to develop the agricultural sector. Such initiatives include the building of dams and irrigation systems throughout Africa, as well as providing agricultural training and support. This cooperation has been a significant factor in boosting Africa's food security.

China-Africa technological cooperation has gained momentum recently, driven by shared interests and mutual benefits (Kirchherr & Urban, 2018). This cooperation spans various sectors, including telecommunications, information technology, e-commerce, digital infrastructure, and capacity building. Here are some critical aspects of China-Africa technological cooperation: Chinese companies like Huawei and ZTE partner with their African counterparts to build and improve Africa's telecommunications networks. Technological collaborations in Africa encompass a variety of projects, including advanced mobile connectivity solutions, Internet of Things platforms, the development of wireless routers in partnership with Huawei, the Rural Star initiative in Ghana, and cloud computing and data centres in South Africa. These initiatives provide a new framework to support the growing economic activities across the continent.

In addition, a cooperative effort is being made to develop the continent's energy and mineral resources. These endeavours encompass establishing power plants and mining facilities across the continent. Key infrastructure projects include the Liquid-to-Coal Plant in Botswana, the Khumani Iron Ore Mine, and the Assuit Transformer Substations and Power Plant in Egypt. These projects boost Africa's export of raw materials and enhance its energy security, underscoring the critical role of exports and

energy in Africa's economic activities and sustainable development (Kirchherr & Urban, 2018). In recent times, cooperation on climate change has notably increased, creating new avenues for joint ventures through the adoption of green technologies in Africa. This collaboration marks a new type of partnership between China and Africa, aiming to establish a "green partnership" that addresses the growing energy needs while ensuring environmental sustainability (Grimm et al., 2021).

Moreover, through strategic partnerships, China has also played a crucial role in advancing various African service sectors, including housing, healthcare, and education (George et al., 2016). Some notable projects spearheaded by China include the development of Modderfontein New Town, the construction of a prefabricated city in South Africa, the building of Mahusekwa Hospital in Zimbabwe, and Heartland Property projects development. These initiatives have greatly enhanced the capacity of human service organizations throughout the continent. The success of these joint efforts largely depends on the commitment and interaction of the involved parties. These stakeholders are poised to continue their pivotal role in propelling Africa's developmental goals.

## 2.5 China-Africa Infrastructure Cooperation's Actors

The actors involved in China-Africa cooperation are responsible for various aspects of infrastructure projects in Africa, including conception, funding, construction, and management Osabutey & Jackson (2019). Key participants from China in the China-Africa infrastructure collaborations include State-Owned Enterprises (SOEs), State-Owned Banks (SOBs), the Ministry of Commerce (MOFCOM), and various government ministries. These entities collaborate with African governments and businesses to deliver financial and technical support for infrastructure developments. On the African side, the

governments, local companies, and civil society organizations are stakeholders. The projects are typically managed by government bodies, which handle negotiations and oversee the projects' progress. Local businesses contribute by offering subcontracting services and specialized skills. In addition, civil society organizations play a crucial role in advocating for and monitoring the projects to ensure they are transparent and accountable and contribute to sustainable development.

Other key entities facilitating China-Africa collaboration on infrastructure projects include the Forum on China-Africa Cooperation (FOCAC), the African Union, and various African regional commissions. These organizations serve as vital platforms for dialogue and collaboration between China and African countries on infrastructure development and other growth initiatives (Zhang, 2014; Vhumbunu, 2017; Jurenczyk, 2020). Together, these actors coordinate the development, funding, and execution of infrastructure projects in Africa to foster regional integration, economic advancement and poverty reduction.

### 2.5.1 Role of Chinese Stakeholders in the context of China-Africa Project Cooperation

China's involvement in African infrastructure development is predominantly facilitated by its state-owned enterprises (SOEs) and financial institutions (Zhang, 2014; Vhumbunu, 2017; Jurenczyk, 2020). Key Chinese SOEs active in this sphere include the China Civil Engineering Construction Corporation (CCECC), and Bridge Corporation (CRBC) among others. These entities are frequently involved in major projects across Africa, such as the construction of railways, ports, roads, and energy and telecommunications facilities. Notable projects include the Mombasa-Nairobi railway in Kenya and the Addis Ababa-Djibouti railway spanning Ethiopia and Djibouti. Additionally, Chinese financial institutions like the Export-Import Bank of China (Exim Bank) and the Development Bank are essential in providing financial support for these infrastructure projects. They extend loans, credit lines, and other financial solutions to African governments, state-owned enterprises, and Chinese contracting companies engaged in development efforts.

Besides these entities, the Chinese government is crucial in promoting infrastructure projects between China and Africa. The Forum on China-Africa Cooperation (FOCAC), which serves as a platform for dialogue and partnership between China and African countries, has established a structure for fostering and coordinating infrastructure developments across Africa (Tan-Mullins et al., 2010). Key Chinese governmental agencies, such as MOFCOM and the Foreign Affairs Ministry, promote and support these infrastructure endeavours (Grimm, 2017). These organizations organize trade missions, offer regulatory advice, and collaborate with African government agencies and other stakeholders.

### 2.5.2 Role of African Stakeholders in the context of China-Africa Project Cooperation

Infrastructure projects between China and Africa involve various African participants, including corporate individuals, groups, and African institutions, from initial planning to final execution. African governments play a pivotal role in shaping the negotiation and execution of these projects, collaborating with Chinese entities to pinpoint critical infrastructure needs, negotiate financial terms and contractual details, and oversee project implementation (Grimm, 2017). These bodies meticulously assess these projects to ensure they align with national development agendas and contribute to regional economic prosperity (Adeniji et al.,2021). Notably, the key regional organisations in Africa, such as the Economic Community of West African States (ECOWAS), the East African Community (EAC), the New Partnership for Africa's Development (NEPAD), and the African Union (AU), have formed partnerships with Chinese counterparts to bolster infrastructure development.

Furthermore, African private sector entities, including local and international firms, are active participants in China-Africa infrastructure projects. These actors contribute as subcontractors or provide auxiliary services such as logistics and transportation during the project lifecycle. International companies might also work alongside African or Chinese firms to vie for contracts or bring specialised technical skills (Yang et al., 2020). For instance, during the construction of the Mombasa-Nairobi railway in Kenya, African companies delivered essential support services like catering and logistics, showcasing their significant role in these projects (Wissenbach & Wang, 2017).

Civil Society Organizations (CSOs) in Africa are not mere observers in China-Africa infrastructure projects. The agency plays a crucial role in influencing the

outcomes of these projects (Ong'ayo, 2011). Through advocacy and awareness campaigns, CSOs enhance transparency, accountability, and public engagement in project decisions (Benabdallah, 2015; Ong'ayo, 2011). The actors' efforts are geared towards ensuring adherence to environmental and social standards and delivering benefits to local communities, underscoring their significant impact on these projects (Lonnqvist, 2008).

Finally, local communities are crucial stakeholders in China-Africa infrastructure projects. While individuals within these communities may benefit from improved access to services and economic opportunities, they may also face land displacement, loss of livelihood, or environmental harm (Mohan, 2015).

Overall, the active involvement and engagement of all these stakeholders in project decision-making are critical to ensuring that the projects are inclusive, sustainable, and ultimately beneficial to the region's economic framework.

# CHAPTER 3
# CHINA'S INFRASTRUCTURE INVESTMENT IN AFRICA: DO AFRICAN FIRMS BENEFIT FROM INTERACTIONS WITH CHINESE FIRMS?

## 3.1 Introduction

How does foreign direct investment (FDI) influence local companies in host countries? Apart from the conventional channel, FDI productivity spillovers, the literature has overlooked other possible impacts of the interaction between local firms and foreign investors. For example, such interactions may also generate a favourable reaction from the stock market due to the signaling effect. Hence, the stock market performance of the involved local firms may also be affected. In this paper, we examine the interaction between Chinese infrastructure investors and African firms by considering the FDI productivity spillover and signaling channels.

Chinese outward infrastructure investment (OII) in Africa is interesting to study. In 2020, China's OII in Africa was 13.5% of total infrastructure investment in Africa ($399 billion), more significant than the 6.8% from traditional donors combined (Russia, European Union, United States, Brazil, United Kingdom, Canada, Australia) (Deloitte, 2020). China's infrastructure projects in Africa primarily involve transport, technology, power generation, and transmission (Busseet al., 2016). Economic theory asserts that these types of investment are drivers in achieving sustainable economic development.

This is the first paper to apply an experimental method to assess China's OII on local firm performance. Though there are observational studies on China's OII, it has generated heated debate. Some researchers view the China-Africa partnership as

mutually beneficial, catalysing African development through significant infrastructure improvements and technological transfers. For instance, Haroz (2011) highlights Angola's experience, where Chinese investments have notably advanced technology transfer and infrastructure development. Similarly, Asayehgn (2009) points to the positive impact of Chinese firms in Ethiopia, compelling local firms to enhance competitiveness through restructuring and increased utilisation of local content. In a cross-country study, Khodeir (2016) focuses on thirty-eight African countries and suggests that Chinese investments have spurred economic interactions across the continent, with notable technology transfers in sub-Saharan Africa compared to northern Africa.

Others argue that it might not lead to substantial spillover effects. For instance, Klaver and Trebilcock (2011) assess China's private investment in Africa, noting its limited potential for spillovers because the investment is location specific. The authors argue further that such spillovers to the broader economy are restricted beyond certain regions. Moreover, Zafar (2007) points out that many Chinese companies prefer to use Chinese nationals in managerial and technical positions, thus limiting skill transfer to the locals. Corkin (2012) observes that this practice is further exacerbated in short-term projects where Chinese donors need more motivation to train low-skilled African parties, indicating a lack of significant investment in training by many Chinese investors.

These mixed observations often hinge on anecdotal evidence and individual case studies, underscoring the need for comprehensive econometric analyses better understand the impacts of China's OII in Africa. Consequently, our study seeks to bridge the existing research gap by investigating the interplay between Chinese infrastructure projects and African enterprises using experimental methods. We aim to empirically

investigate how these interactions impact the performance of the involved African companies, addressing a crucial question in understanding the nuanced spill-over effects of China's OII in Africa on local firm performance.

We contribute in the following aspects. Firstly, we extend the literature on how China's OII affects local firms by documenting productivity spillover and notably, the stock market's response. Existing studies explain the impact of FDI on local firms through FDI productivity spillovers. Still, they overlook how the stock market reacts to the interaction between local firms and foreign investors. This paper examines how interactions with Chinese infrastructure investors affect African firms by considering both the FDI productivity spillover and signaling channels. We document that such interactions may not always generate productivity spillovers, but they may boost the stock market valuation of the involved African firms due to the signaling effect. We argue that this strong signaling effect can be due to the Chinese government's involvement in infrastructure projects in Africa. Secondly, we define firm interactions based on infrastructure projects; hence, the linkage between local firms and foreign investors is measured directly at the firm level. Specifically, weidentify the interaction of an African firm with Chinese investors by determining whether the African firm is the local counterpart of China's infrastructure project. In the FDI productivity spillover literature, the proxy for the linkage between local firms and foreign investors is often derived from aggregate data, such as the prevalence of foreign investors within an industry (horizontal) and the input-output coefficient (vertical); hence, firm linkages are often not directly measured on the firm level.[1] Thirdly, we extend the literature on

[1] Newman et al. (2019) use a firm level measure. They identify direct FDI linkages between MNEs and local firms by interviewing MNEs and link them to local firms, and then they examine whether this linkage leads to direct transfer of technology/ knowledge from multinationals to focal firms.

Chinese investment in Africa by shifting the focus from macro-level to firm-level analysis. Although some studies document that China's OII is overall beneficial for African economies, the channels through which China's investment may foster economic growth in Africa are unclear (Donou-Adonsou & Lim, 2018). Hence, we present evidence at firm level. We believe that firm-level evidence can provide deeper insights for policymakers since it reveals concrete mechanisms by which China's infrastructure investments influence the economies of the host countries. To our knowledge, the economic effects of the firm-level interaction between China and Africa facilitated by China's infrastructure projects in Africa have not been econometrically documented in the literature. We address this gap in the literature. Furthermore, our research differentiates between general Chinese outward foreign direct investment (OFDI. Previous studies on China's general OFDI, which includes numerous private enterprises, fail to capture the distinctive aspects of the Chinese government's direct involvement in providing infrastructure to developing host countries. It is worth noting that China's OII is a Chinese government-led global operation with multiple state-owned banks (SOBs) and state-owned enterprises (SOEs) as participants. Therefore, examining the interaction of these Chinese SOEs with local African firms can reveal deep insights into how Chinese government-financed infrastructure investment affects host countries.

We examine a panel of 503 African-listed firms during 2010–2021, including 51 firms that interact with Chinese firms via China's infrastructure projects in Africa. Applying the Heckman two-stage selection model, we find that firm interactions

Newman et al. (2019) use a firm level measure. They identify direct FDI linkages between MNEs and local firms by interviewing MNEs and link them to local firms, and then they examine whether this linkage leads to direct transfer of technology/ knowledge from multinationals to focal firms.

increase the stock market valuation of the involved African firms. However, we did not obtain evidence that such interactions improve African firms' accounting performance, measured by the return on assets or labour productivity. This result suggests that the interactions between Chinese and African firms do not generate productivity spillovers. Nevertheless, we uncover strong evidence that stock market investors take such interactions as a positive signal of the involved African firms. We believe that the Chinese government's direct involvement in these infrastructure projects and theimplied strong resource commitment reduce the asymmetric information problem of the involved African firms, which leads to stronger demand for these firms' stocks andboosts these firms' stock market valuation. We also find that Chinese ownership of theinvolved local African firms enhances the signaling effect, but the presence of Chinesedirectors on the boards of the involved African firms reduces labour productivity.

The remaining structure of this paper is as follows: Section 2 reviews pertinent literature and theoretical frameworks, leading to the formulation of hypotheses. Section 3 details the sample, data, empirical methodologies, and measurement of variables. Section 4 presents the analysis of the empirical results. The paper concludes with Section 5.

## 3.2 Related Literatures, Underlying Theories and Hypotheses

Our research examines whether African firms benefit from their interactions with Chinese firms through China's infrastructure projects in Africa. Therefore, our research is related to existing theories and findings on how foreign investors influence local businesses.

### 3.2.1 Linkage between FDI and Local Firms: Productivity Spillovers

Research on FDI productivity spillovers highlights that local companies can gain from technology diffusion, knowledge transfer from foreign firms, and the broader benefits of FDI (Alfaro, 2017). These productivity spillovers encompass the sharing of technology and knowledge, which include management techniques, marketing strategies, employee training, and expansion of export networks. Spillovers occur through connections with foreign firms within the same industry (horizontal) or across different sectors (vertical). A recent analysis by Saurav and Kuo (2020) examines the effects of FDI on local companies. They discover that local firms within the same industry as foreign investors often see negligible or negative spillovers. In contrast, local suppliers to foreign companies (upstream or backward linkages) significantly benefit from FDI-induced productivity gains. However, the outcomes for local firms that purchase from or distribute for foreign investors (downstream or forward linkages) show mixed results. Moreover, several studies suggest that FDI productivity spillovers are more likely to occur in backward linkages (for example, Gorg & Greenaway, 2004; Smarzynska-Javorcik, 2004). Specifically, Smarzynska-Javorcik (2004) reported positive productivity spillovers among Lithuanian supplier firms working with foreign affiliates. However, there is a lack of solid evidence supporting spillovers through horizontal or forward linkages. Saurav and Kuo (2020) outline that productivity spillovers to local upstream firms from FDI (backward linkages) occur via mechanisms such as (a) direct assistance, which involves the transfer of technology and production techniques, training of management and workers, enhanced production inputs, and increased financing; (b) quality mandates, where local firms improve their production and management practices to meet higher standards set by foreign investors; and (c) the

scale effect, driven by the growing demand for local intermediate goods from FDI investors.

The literature also indicates that the efficacy of FDI productivity spillovers is contingent on local firms' characteristics, such as their absorptive capabilities (Ascani & Gagliardi, 2020; Chen et al., 2007). Furthermore, the motivation behind foreign investments can also alter the impact of productivity spillovers on local businesses. For instance, Nunnenkamp and Spatz (2004) suggest that market-seeking FDI in the services and manufacturing sectors can introduce new products and modernize production in host economies. Efficiency-seeking FDI, on the other hand, often allows local downstream suppliers to adopt more advanced technologies and expertise through adaptation and imitation. Conversely, resource-seeking FDI in the primary sector typically fails to establish productive linkages with local firms. Reyes (2017) notes that efficiency-seeking FDI produces more significant spillovers than market-seeking FDI. Meanwhile, FDI aimed at extracting natural resources does not lead to productivity gains for local companies.

The evidence regarding FDI productivity spillovers in African nations is inconclusive. For instance, Bwalya (2006) studied 125 manufacturing firms in Zambia from 1993 to 1995, documenting productivity spillovers through backward linkages with local input suppliers from foreign firms. However, Bwalya observed minimal horizontal productivity spillovers; local firms' productivity declined with increased foreign presence in the same sector, supporting the adverse competition effects. Morrissey (2012) suggests that studies on FDI productivity spillovers in sub-Saharan Africa need to differentiate between linkages and actual spillovers due to the region's minimal manufacturing FDI and predominant focus on resource extraction. Morrissey (2012)

points out that FDI in resource extraction mainly provides basic employment for unskilled labour and contributes a portion of export earnings, with limited value-added processing or knowledge transfer. Consequently, linkages in sub-Saharan Africa seldom led to productivity spillovers, particularly in the case of Chinese investments, which are largely in infrastructure projects employing imported machinery, equipment, and labour, thus creating minimal local linkages or spillovers. Furthermore, a study by Amendolagine et al. (2013) analysing firm-level survey data from around 1,400 foreign investors in the manufacturing sector across 19 sub-Saharan African countries found a negative correlation between Chinese investments and linkages with local firms. They attribute this to increased transaction costs due to cultural and linguistic differences and the high involvement of state-owned enterprises (SOEs) in Chinese investments, which are politically backed and rely on importing intermediates from China.

While some African studies have shown minimal productivity spillovers from Chinese OFDI, Rui et al. (2016) found that Chinese Multinational Companies (CMNCs) impart pertinent knowledge to local enterprises. Their research involved case studies of 19 CMNCs engaged in infrastructure projects across Africa between 2008 and 2015. According to the authors, the knowledge transferred was not necessarily 'superior' but rather 'relevant', tailored to local firms' needs and capable of being assimilated by them. However, Rui et al. (2016) did not specifically investigate whether this transfer of relevant knowledge boosts the productivity of local African businesses.

From the literature reviewed, there is no consensus on whether Chinese infrastructure investments lead to productivity spillovers for African firms. Some scholars contend that the productivity impacts might be minimal because many of China’s infrastructure projects in Africa are resource-seeking, involving little value-

added processing where knowledge transfer and learning could occur. Despite this, given that China's investments predominantly target the resource-rich primary sector, we propose that these investments still have the potential to create productivity spillovers for African firms involved due to their distinctive characteristics. Notably, the typical discussions on FDI productivity spillovers in the literature usually focus on non-infrastructure investments made primarily by private multinational corporations. In contrast, China's infrastructure investments in Africa are distinct because they involve direct engagement from the Chinese government. This involvement typically includes direct support in financing, inputs, management skills, and training for local employees (Du, 2016). For instance, Saurav and Kuo (2020) suggest that such direct assistance is a potent mechanism for generating productivity spillovers in local firms. Similarly, Carrai (2021) demonstrates that Chinese state-owned enterprises (SOEs) managing large infrastructure projects in Ethiopia actively provide training for local workers. These observations lead us to hypothesize that through direct assistance in finance, inputs, management training, and workforce development, Chinese SOEs can significantly boost productivity in local firms. Taken together, we set up the following hypothesis:

***Hypothesis 1****: The interaction between Chinese and African firms through China's infrastructure projects in Africa may generate productivity spillovers for the involved African firms, which enhance these firms' accounting performance (return on assets and labor productivity).*

### 3.2.2 The Signaling Effect

Why does the involvement of local African firms in Chinese infrastructure projects generate a positive signal for the involved local firms? We further justify our argument with the Resource Dependency Theory (RDT) (Hillman & Dalziel, 2003; Hillman et al., 2009) and the Resource-Based View (RBV) (Barney, 1991). RDT focuses on how

access to external resources strengthens the firm's competitive advantages. In our research, RDT is relevant since China-Africa infrastructure interactions provide the involved local African firms with opportunities to gain external resources, which may enhance their performance. On the other hand, On the other hand, the benefits that local African firms derive from their engagements with Chinese infrastructure investors hinge on the capabilities of these investors. RBV is relevant because it explains why Chinese infrastructure investors have competitive advantages and are potentially strong resource providers for the involved African firms.As mentioned, Chinese infrastructure investors interacting with local African firms aremainly SOEs. These Chinese SOEs are normally large, listed firms in China with an established business network and they have access to Chinese state-dominated formal financing and hence face fewer financial constraints. Specifically, they are supported by the government financing for infrastructure projects in Africa and they bring materials and equipment to the projects.[2] Cuervo-Cazura and Li (2021) point out that the resource-based view is an important theory underlying the internationalization of state-owned multinationals. State-owned firms have preferential access to state resources, including investment financing, favourable regulation, and governmentsupport to facilitate dealings with host country governments.

The application of RDT and RBV enables us to argue that Chinese SOEs, which interact with local African firms, have competitive advantages in resources; hence, in theory, the involved African firms can benefit from strong resource commitment from Chinese SOEs, which is suitable for both the accounting and stock market performance

[2] Brautigam and Hwang (2016) calculated that from 2000 to 2014, infrastructure loans in Africa from China's two policy banks stipulated that a minimum of 50% of goods and services purchased with these loans must originate from China.

of the involved African firms. Local African firms strive to be involved in China's infrastructure projects when they recognise these potential benefits. This is because local firms involved with Chinese state-owned enterprises (SOEs) have the potential to experience productivity spillovers. Even without the consideration of productivity spillovers, the involvement of local firms at least sends out a positive signal to stock market investors about the quality and prospects of these involved African firms. Consequently, the Chinese government's involvement reduces information asymmetry and the implied strong resource commitment in these projects, ultimately enhancing the stock market valuation of the involved African firms. Hence, we have:

***Hypothesis 2:*** *The relationship between Chinese and African companies in the scope of China's infrastructure projects in Africa might create a signaling effect for the African firms involved, potentially improving their stock market performance.*

Firm performance determinants used by the existing studies are supported in scholarly literature. For instance, firm size, as suggested by Rajan and Zingales (1998), offers insights into resource access and market presence, essential for engaging in large-scale projects. The ratio of R&D spending to total sales, which indicates a firm's commitment to innovation, underscores the significance of absorptive capacity in capitalising on FDI, a concept emphasized by Cohen and Levinthal (1990) and further explored by Xie et al. (2018). Sales growth signifies the firm's market success and expansion capabilities, aligning with Penrose (2009) views on growth potential. Leverage and cash flow, critical for understanding a firm's financial structure and operational efficiency, draw on foundational theories by Modigliani and Miller (1958) and Myers and Majluf (1984), respectively. Lastly, the firm's export orientation, indicating its international market engagement, is linked to higher productivity and growth rates, as Bernard and Jensen (1999) have identified. Together, these variables

create a strong framework for examining the impact of infrastructure investments on African firms' strategic direction and performance in the context of their partnerships with Chinese companies.

### 3.2.3 Moderating Factors: Corporate Governance

If the conjectures mentioned above are justified, then the extent to which Chinese infrastructure investors intervene in the corporate governance of the involved local African firms would change both the productivity spillover effect and the signaling effect. In this section, we introduce two moderating factors related to corporate governance. We use Chinese ownership of the involved African firms (*Ownership*) and whether a Chinese director sits on the board of the involved African firm (*Director*). Different theories predict different directions in which these two corporate governance factors change the productivity spillover effect and the signaling effect. Based on the resource dependency theory and the resource-based view mentioned earlier, a stronger involvement of Chinese infrastructure investors in the corporate governance of local African firms would suggest a larger resource commitment from Chinese SOEs,which should be beneficial for both the accounting and stock market performance of the involved African firms. Hence, we can hypothesize that:

***Hypothesis 3a****: Chinese investors' involvement in the corporate governance of the involved African firms (ownership and director) reinforces both the productivity spillover effect and the signaling effect.*

However, a heavier involvement of Chinese infrastructure investors in the corporate governance of African firms may also result in additional agency conflicts in the involved African firms. These agency conflicts intensify if China's infrastructure investments are driven by the desire to tap into the primary industry market and influence government policies (Hendrix, 2020; Asiedu & Esfahani, 2001). In addition, agency

conflicts also arise due to differences in local and foreign companies' corporate governance laws and objectives (Masulis et al., 2012). Moreover, foreign directors may be less familiar with local firms' accounting rules, management operations, cultural distances, and corporate governance standards; hence, monitoring and evaluating management performance is complex (Mustapha, 2011). It has been documented that Chinese OII is is primarily driven by the resource (Morrissey, 2012; Sanfilippo, 2010).[3] For example, Sanfilippo (2010) claims that most of these projects in Africa are often tied to exploitation of natural resources, which can be achieved through directorship and ownership of local firms. If this is the case, then Chinese infrastructure investors may be indifferent towards the performance of local firms. Additionally, previous research has shown that language and cultural differences between Chinese investors and local firms raise transaction costs (Amendolagine et al., 2013). Therefore, agency theory predicts that the involvement ofChinese infrastructure investors in the corporate governance of local African firms mayweaken both the productivity spillover effect and the signaling effect.

***Hypothesis 3b**: Chinese investors' involvement in the corporate governance of the involvedAfrican firms (ownership and director) weakens the productivity spillover and signaling effects.*

## 3.3 Empirical Design

### 3.3.1 Data and Sample

In analysing the interaction between China and Africa via infrastructure projects, we constructed our dataset using the China Global Investment Tracker (CGIT), online

[3] For example, Brautigam and Gallagher (2014) note that approximately 56% of infrastructure loans to African nations were settled through commodities (frequently natural resources) between 2003 and 2011. A significant portion of these repayments in commodities were associated with infrastructure projects initiated by China.

reports, and annual financial statements from companies listed on African stock exchanges. This dataset uniquely focuses on non-financial firms that have engaged in infrastructure projects with Chinese firms, encompassing a varied array of sectors across the continent. Our analysis deliberately centers on firms listed on any of the seventeen active African stock exchanges, a choice motivated by the need to study entities held to stringent transparency and regulatory standards. This selection criteria excludes financial institutions but ensures a diverse representation of industries, thereby aiming to capture the multifaceted nature of Chinese infrastructure investments in Africa.

Our sample includes 51 African firms listed on stock exchanges, identified through the CGIT as being involved in infrastructure projects with Chinese state-owned enterprises (SOEs). This selection, while offering a targeted lens on the subject, introduces potential selectivity concerns that could impact our conclusions. To mitigate and correct these biases, we implemented a rigorous methodological framework using the Heckman two-stage approach. This strategy allows us to account for the non-randomness inherent in our sample by including the involved firms with a control group of 452 non-involved, listed non-financial African firms, thus providing a more balanced and comprehensive view.

Data on outcome and control variables were meticulously extracted from Thomson DataStream and the African financials database, with additional governance information derived from the audited annual reports of the sampled firms. Matching this information with CGIT data facilitated a nuanced analysis of the interaction between these African entities and their Chinese partners. However, due to the absence

of complete data for some firms, adjustments were made to refine the sample. Consequently, our final analysis relies on a panel of 503 listed non-financial African firms, incorporating both those directly engaged in Chinese infrastructure projects and those not involved, covering the period from 2010-2021. This detailed sample construction is crucial for addressing the challenges of sample selectivity and its implications, ensuring the robustness and reliability of our findings regarding the economic impact of China's OII in Africa. The data classification of firms can be found in the Appendix.

### 3.3.2 Empirical Models and Measurement of Variables

When studying the effects of China-Africa infrastructure engagements on African firms, it is imperative to address the issue of sample selection bias. To ensure the rigour of our research, we employ the Heckman two-stage model. This approach provides a solid framework for addressing sample selection bias and reducing problems with endogeneity (Certo et al., 2016). This model starts with a probit model to delineate the selection process, followed by an OLS regression to assess the outcomes of interest. The application of the Heckman model is grounded in its capacity to adjust for sample selection bias, enhancing the validity of empirical findings by incorporating exclusion restriction (ER) variables. These ER variables, which influence the selection process without directly impacting the outcome variable, are pivotal for reducing multicollinearity among predictors and decoupling the error terms in the equations (Heckman & Vytlacil, 2001).

In this context, we introduce institutional distance (*INST*) as an exclusion restriction variable, elucidating the regulatory and business environment disparities between the African host countries and China. The relevance of institutional distance as

an ER variable is deeply rooted in institutional theory, which asserts that the institutional framework within which firms operate significantly shapes their strategic decisions and outcomes (North, 1990; Scott, 1995). The institutional gap between the African nations and China is crucial in determining which local firms are selected for infrastructure projects within the context of China-Africa engagement. These firms must contend with the complexities of interacting with Chinese entities, influenced by the broader institutional differences between the partnering countries.

Although institutional distance is a macro-level variable, its ramifications extend to the micro (firm) level, influencing how companies navigate and perform within these international partnerships. The more the institutional distance, the higher the potential transaction costs and uncertainties for African firms involved in Chinese infrastructure projects, which could, in turn, affect their operational performance. This perspective is supported by Meyer et al. (2009), who argue that institutional differences can affect the efficiency and success of cross-border collaborations, as firms must adapt to disparate regulatory and business practices.

Furthermore, the use of institutional distance as an ER variable addresses a common critique in the literature regarding the application of country-level variables to explain firm-level outcomes. Gaur, Kumar, and Singh (2014) defend this approach by demonstrating that macro-level institutional factors significantly influence firm-level strategic decisions and performance outcomes, through the mediation of transaction costs and market uncertainties. This aligns with our rationale for selecting institutional distance as an ER variable; it significantly impacts the likelihood of a firm's selection into China's infrastructure investments without being directly related to the firm's

performance, thus serving as an effective instrument in our Heckman model. This careful justification and selection of institutional distance as an identifying variable, supported by literature, underscores our model's capacity to generate insights into the nuanced effects of China-Africa infrastructure investments on African firms, while rigorously addressing concerns of endogeneity and selection bias.

Our first stage empirical model is specified as follow:

$$Probability\ (Counterpart_{it} = 1) = \alpha_0 + \alpha_1 SIZE_{it-1} + \alpha_2 RD_{it-1} + \alpha_3 SG_{it-1} + \alpha_4 LEV_{it-1} + \alpha_5 CF_{it-1} + \alpha_6 EX_{it-1} + + \alpha_7 PP_{it-1} + \alpha_8 PRI_{it-1} + \alpha_9 GDP_{it-1} + \alpha_{10} INST_{it-1} + f_i + f_t + \mu_{it} \quad (1)$$

In the initial model (Model 1), we utilize a probit model where the dependent variable is a dummy variable (Counterpart) assigned a value of one if the African firm is the local counterpart in China's infrastructure project and zero otherwise. We examine a set of variables to determine why an African firm is a participant in the Chinese project. We include some firm characteristics such as firm ($SIZE$), research expenditure ($RD$), sales growth ($SG$), leverage ($LEV$), cash flow ($CF$), export-orientation ($EX$), past performance ($PP$) (the lagged-one returns on assets). We will explain measurements of these firm-level variables in detail below. We incorporate a dummy variable for the primary industry ($PRI$) to account for the resource-seeking motive behind China's infrastructure investments. This variable is assigned a value of one if the firm operates within the primary industry and zero otherwise. This comprises of mining, energy, metals, agriculture, forestry and fishing sectors. This was obtained from the *CGIT* database. Moreover, we use the gross domestic product ($GDP$) as a proxy for the market size of the host country where the local firm is based. This is the logarithm of the host country's GDP per capita, sourced from the *World Bank Development Indicator*

*Database*. Cheung et al., (2014) assert that Natural resources and market size are strong attraction factors for Chinese infrastructure investment in Africa. In addition, we introduce the variable COVID-19 (*COVID*) to assess the pandemic's impact on foreign investment. COVID-19 influences all facets of life (Fu, Alleyne & Mu, 2021). This dummy variable is assigned a value of one in any year the COVID-19 pandemic occurs and zero otherwise. The data on COVID-19 is obtained from the World Health Organization (2020). Furthermore, we incorporate a variable for exclusion restriction (*INST*) in the treatment model *(equation (1))*. Here, INST represents the institutional distance between China and the host country. Institutional distance (*INST*) is calculated as the difference between the economic freedom score of China and that of the host country (Deng, Yan & Van Essen, 2018). The information on economic freedom index is obtained from the *Wall Street Journal and Heritage Foundation database.*[4] Institutional distance matters for the adaptation cost of foreign investors in adjusting to the host country. We believe that *INST* can explain why a local firm is chosen to be the counterpart of Chinese infrastructure projects, but institutional difference does not directly affect local firms' performance in Africa. To mitigate the issue of endogeneity, all variables at the firm, industry, and country levels are lagged by one year.

In the second-stage model (2), we investigate the correlation between proxies for firm interactions and the performance of the 51 participating African firms, after controlling for other relevant variables, including the Inverse Mills Ratio (IMR). IMR is

[4] Economic freedom Index, as defined by the Heritage Foundation in 2022, assesses the effectiveness of political and economic institutions across nations using 12 criteria. These criteria include tax burden and financial freedom, investment freedom, property rights, monetary freedom, trade freedom, judicial effectiveness, government integrity, government spending, fiscal health, labour freedom and business freedom.

also known as Lambda. Thus, the second stage empirical model is as follow:

$$Perform_{it} = \beta_0 + \beta_1 INFRA_{it-1} + \beta_2 SIZE_{it-1} + \beta_3 RD_{it-1} + \beta_4 SG_{it-1} + \beta_5 LEV_{it-1} + \beta_6 CF_{it-1} + \beta_7 EX_{it-1} + \beta_8 IMR + f_i + f_t + \varepsilon_{it} \quad (2)$$

Where $Perform$ signifies firm performance, which is evaluated using three metrics. First, we assess the firm's accounting performance through the return on assets ($ROA$), defined as the ratio of operating profits to total assets. We also examine labor productivity ($LP$), calculated as the firm's net income divided by the total number of employees. The data for these metrics are obtained from Thomson DataStream. Second, we evaluate the firm's stock market performance using market value added ($MVA$), where $MVA$ is calculated by subtracting the book value from the market value of the firm and then dividing by the firm's total assets.

Our primary independent variable in model (2) represents the interaction between Chinese and African firms through infrastructure projects. We measure this through the size of China's infrastructure investment ($INFRA$), defined by the amount of Chinese investment in the infrastructure project involving the African firm at time t. scaled by total Chinese infrastructure investment in Africa at time t. The size of Chinese investment in the infrastructure project should directly matter for the involved African firms. Larger infrastructure investment suggests heavier Chinese government's involvement and stronger potential resource commitment in the project.

In both empirical models (1) and (2), We account for several characteristics of the firm. Precisely, we measure firm size by the natural logarithm of total assets, which indicates market position and a firm's resource base, affecting its ability to engage internationally (Rajan & Zingales, 1998). R&D expenditure is included as a proxy for a firm's absorptive capacity, crucial for leveraging external knowledge and innovation (Cohen

& Levinthal, 1990). Sales growth indicates a firm's market performance and expansion capabilities, directly linked to its operational success (Penrose, 1959). Leverage and cash flow are financial metrics indicative of a firm's financing structure and operational efficiency, affecting its investment decisions and risk profile (Modigliani & Miller, 1958). Lastly, export-orientation highlights a firm's market reach and international competitiveness, factors that correlate with higher productivity and growth (Bernard & Jensen, 1999). Collectively, these variables provide a nuanced framework for analyzing how China-Africa infrastructure investments influence the performance and strategic decisions of African firms, grounded in a rich tapestry of economic and business theories. A comprehensive description of the variables is included in the appendix.

To examine the moderating influence of corporate governance variables (*Ownership* and *Director*), we use the empirical models (3) and (4):

$$Perform_{it} = \beta_0 + \beta_1 INFRA_{it-1} + \beta_2 INFRA_{it-1} * Ownership_{it-1} + \beta_3 Ownership_{it-1} + \beta_4 SIZE_{it-1} + \beta_5 RD_{it-1} + \beta_6 SG_{it-1} + \beta_7 LEV_{it-1} + \beta_8 CF_{it-1} + \beta_9 EX_{it-1} + \beta_{10} IMR + f_i + f_t + \varepsilon_{it} \quad (3)$$

$$Perform_{it} = \beta_0 + \beta_1 INFRA_{it-1} + \beta_2 INFRA_{it-1} * Director_{it-1} + \beta_3 Director_{it-1} + \beta_4 SIZE_{it-1} + \beta_5 RD_{it-1} + \beta_6 SG_{it-1} + \beta_7 LEV_{it-1} + \beta_8 CF_{it-1} + \beta_9 EX_{it-1} + \beta_{10} IMR + f_i + f_t + \varepsilon_{it} \quad (4)$$

In model (3), $Ownership$ refers to Chinese ownership of the involved African firm, which is the share ratio held by Chinese firms in the involved African firm. In model (4) $Director$ signifies whether there are Chinese directors on the board of the involved African firm. It is assigned a value of one if at least one Chinese director is on the board and zero if none. The information on board directors and ownership structure of African firms was obtained from the firms' annual reports.

### 3.3.3 Summary Statistics

Table 3.1 shows the several preliminary insights into the dynamics of China's OII and

African firms' performance. The descriptives are based on the whole sample of 503 companies (including the firm that interact and those that do not). Firstly, the average values for market value added, return on sales, and log of labour productivity indicate a generally positive performance among the sampled firms. The fact that these mean values are significantly positive suggests that, on average, the firms in the sample are profitable and productive. This is further supported by the average sales growth rate of 0.27, which indicates good growth opportunities for these firms. The presence of a positive mean for research and development (0.32) and export orientation (0.40) suggests that these firms are not only investing in innovation but are also significantly engaged in international trade, which could be contributing factors to their overall positive performance. However, the presence of negative minimum values for market value added and return on assets indicates variability and the existence of underperforming firms within the sample. This variability is further evidenced by the standard deviations, suggesting a wide range of performance outcomes among the sampled firms.

The table also highlights the relatively low, but non-negligible, influence of Chinese investment and involvement within these African firms. With 14% of the sampled firms being local counterparts to Chinese infrastructure projects, and with mean values for Chinese ownership and directors on board at 0.05 and 0.02, respectively, it implies a direct but limited presence of Chinese stakeholders in the governance and ownership structures of these firms. This limited direct involvement could suggest that while Chinese infrastructure projects are prevalent, their direct control or influence over these firms remains moderate. This could be beneficial from a local autonomy perspective, allowing African firms to leverage Chinese investments without

significantly ceding control.

Furthermore, the statistics shed light on the financial structure and sector distribution of the sampled firms. The average leverage ratio of 0.48 indicates a moderate level of debt relative to assets, which suggests that these firms are utilising debt financing but are not overly leveraged. This ratio can be crucial for sustaining growth without excessive financial risk. Furthermore, with an average of 0.26 of the firms operating in the primary sector, a substantial segment of the sample is engaged in traditional industries like extraction, mining, and agriculture, which play crucial roles in most African economies. The average institutional difference of -18.66 suggests that the African countries in our study generally exhibit greater economic freedom than China. This disparity may affect how these nations handle foreign investments and manage local enterprises.

**Table 3.1 Descriptive Statistics**

| | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Market value added | 0.39 | 0.40 | -0.90 | 6.68 |
| Return on assets | 0.39 | 0.41 | -0.94 | 0.96 |
| Labour productivity | 8.93 | 3.37 | 1.00 | 19.45 |
| Counterpart | 0.14 | 0.34 | 0.00 | 1.00 |
| Infrastructure investment | 0.26 | 0.08 | 0.00 | 1.00 |
| Chinese ownership | 0.05 | 0.10 | 0.00 | 1.00 |
| Chinese director | 0.02 | 0.12 | 0.00 | 1.00 |
| Firm size | 17.00 | 9.29 | 0.70 | 29.99 |
| Research expenditure | 0.32 | 0.25 | 0.01 | 1.44 |
| Sales growth | 0.27 | 0.65 | -0.99 | 9.74 |
| Leverage | 0.48 | 0.79 | 0.08 | 58.00 |
| Cashflow | 0.40 | 0.40 | -0.98 | 2.18 |
| Export orientation | 0.40 | 0.49 | 0.00 | 1.00 |
| Primary | 0.26 | 0.44 | 0.00 | 1.00 |
| GDP per capita | 8.11 | 0.70 | 5.76 | 9.32 |
| Institutional distance | -18.66 | 26.91 | -65.00 | 30.00 |

Note: Number of observations = 6036. Labour productivity, firm size and GDP per capital are in log form. See Appendix I for the measurement of variables and definition.

Next, our model employs a propensity score matching (PSM) approach to address potential asymptotic biases in our sample. Roberts & Whited (2013) and Shipman et al. (2017) outlined that using a PSM model effectively minimises self-selection biases. PSM can be expressed using the binary choice model defined below.

$$D_i = \alpha + \beta X_i + \varepsilon_i \qquad (5)$$

The treated observations (i.e., Di = 1) are matched with the control/untreated observations (i.e., Di = 0) that have the highest propensity score. According to the research design of our study, firms that interacted with the Chinese are referred to as "treated," while those that did not are the control group. Generally, the PSM generates a sample with common support or overlap (i.e., a sample of treated and untreated individuals with similar characteristics across Xi).

Furthermore, the statistics shed light on the financial structure and sector distribution of the sampled firms. The mean leverage ratio of 0.48 indicates a moderate level of debt relative to equity, which suggests that these firms are utilizing debt financing but are not overly leveraged. This balance can be crucial for sustaining growth without incurring excessive financial risk. Additionally, with 26% of the firms being in the primary industry, it reflects a significant portion of the sample involved in sectors such as agriculture, mining, and extraction, which are traditionally important for many African economies. The negative mean institutional difference of -18.66 indicates that, on average, the African countries in the sample have more economic freedom compared to China, which might influence how these countries engage with foreign investments and manage their domestic firms.

The results of the covariate bias reduction are shown in Table 3.2. The t-test probabilities for the variables under consideration are not significant. Hence, the non- significant T-test result indicates that we have achieved a balance between the observable covariances. Thus, the matching was effective in reducing covariate bias.

**Table 3.2 Propensity Score Matching Estimation**

| | Treated | | Control | | | |
|---|---|---|---|---|---|---|
| Variable | Obs | Mean | Obs | Mean | Differences | T-test |
| Market value added | 612 | 0.43 | 5424 | 0.40 | 0.03 | 0.83 |
| Return on asset | 612 | 0.37 | 5424 | 0.39 | -0.02 | -0.67 |
| Labour productivity | 612 | 8.71 | 5424 | 8.90 | -0.19 | -0.87 |
| Investment | 612 | 0.44 | 5424 | 0.00 | 1.00 | 0.76 |
| Chinese director | 612 | 0.24 | 5424 | 0.00 | 0.24 | 0.15 |
| Chinese ownership | 612 | 0.51 | 5424 | 0.00 | 0.51 | 0.70 |
| Firm Size | 612 | 12.29 | 5424 | 12.74 | -0.45 | -0.80 |
| Research expenditure | 612 | 0.30 | 5424 | 0.31 | -0.01 | -0.03 |
| Sales growth | 612 | 0.27 | 5424 | 0.28 | -0.01 | -0.69 |
| Leverage | 612 | 0.43 | 5424 | 0.41 | 0.02 | 1.21 |
| Cash flow | 612 | 0.35 | 5424 | 0.34 | 0.01 | 0.62 |
| Export orientation | 612 | 0.64 | 5424 | 0.67 | -0.03 | -1.04 |
| Primary | 612 | 0.48 | 5424 | 0.47 | 0.01 | 0.17 |
| GDP per capita | 612 | 8.33 | 5424 | 8.37 | -0.04 | -1.17 |
| Institutional Distance | 612 | -8.90 | 5424 | -7.49 | -1.41 | -0.89 |

Table 3.2 reports the propensity score matching estimates results for the variables underconsideration. Firms that interact with the Chinese are termed “treated” while those that do not interactwith the Chinese are the control group. Investment is infrastructure investment.

Table 3.3 shows the correlation matrix, which indicates that there is no significant multicollinearity among the variables. In addition, the Variance Inflation Factor (VIF) for these variables has been examined (details provided in the appendix), revealing that all VIF values fall below the critical threshold of 10. Therefore, the correlation matrix and the VIF analysis confirm that multicollinearity is not a significant issue in our analysis.

**Table 3.3 Correlation Matrix**

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.00 | | | | | | | | | | | | | | | |
| 2 | 0.41 | 1.00 | | | | | | | | | | | | | | |
| 3 | -0.13 | -0.03* | 1.00 | | | | | | | | | | | | | |
| 4 | 0.02 | -0.01 | 0.00 | 1.00 | | | | | | | | | | | | |
| 5 | -0.01 | 0.05 | 0.02 | -0.09* | 1.00 | | | | | | | | | | | |
| 6 | -0.07* | -0.04 | -0.01 | 0.19* | -0.30* | 1.00 | | | | | | | | | | |
| 7 | -0.02 | -0.05 | -0.02 | 0.30* | -0.41 | 0.30* | 1.00 | | | | | | | | | |
| 8 | -0.40* | -0.30 | 0.17* | -0.18* | 0.10 | -0.02 | -0.05* | 1.00 | | | | | | | | |
| 9 | 0.02 | 0.04 | 0.02 | -0.03* | 0.02* | -0.06* | -0.02 | 0.01 | 1.00 | | | | | | | |
| 10 | 0.26 | 0.25 | -0.12* | 0.00 | 0.02 | -0.05* | -0.01 | -0.29 | 0.00 | 1.00 | | | | | | |
| 11 | 0.13 | 0.10 | -0.02 | -0.02 | 0.02 | -0.01 | -0.01 | -0.08 | 0.00 | 0.06 | 1.00 | | | | | |
| 12 | 0.34 | 0.35 | -0.09 | -0.02 | 0.05 | -0.01 | -0.01 | -0.30 | 0.04 | 0.24 | 0.10* | 1.00 | | | | |
| 13 | 0.03 | 0.00 | 0.04* | 0.25* | -0.11 | 0.07 | 0.10* | -0.07 | -0.04 | -0.03* | -0.01 | 0.02 | 1.00 | | | |
| 14 | 0.00 | -0.01 | -0.01 | 0.17* | -0.09* | 0.08 | 0.12 | -0.02 | -0.04 | -0.02 | 0.01 | -0.03 | 0.15 | 1.00 | | |
| 15 | -0.01 | -0.01 | 0.03* | -0.07* | 0.02 | 0.09 | 0.03 | 0.01 | -0.05 | -0.05* | 0.02 | 0.04 | 0.16 | 0.15 | 1.00 | |
| 16 | -0.04* | -0.05* | 0.02 | 0.07* | -0.04* | 0.05 | 0.05 | -0.04* | -0.02 | -0.03* | -0.04* | -0.03 | 0.31 | 0.15* | 0.22* | 1.00 |

Note: * implies 5% level of significance

*1- Market value added* *2- Return on assets*
*3.-Labour productivity* *4- Counterpart*
*5- Chinese director* *6-Chinese ownership*
*7- Infrastructure investment* *8- Firm size*
*9-Research expenditure* *10- Sales growth*
*11- Leverage* *12-Cashflow*
*13- Export orientation* *14- Primary industry*
*15- GDP per capita* *16- Institutional distance*

## 3.4 Empirical Results

### 3.4.1 Explaining whether an African Firm is a Local Counterpart of China's Infrastructure Project

In the first stage of our model, we investigate the determinants that influence an African firm's likelihood of partnering with Chinese infrastructure projects. The findings in Column (1) of Table 3.4 reveal significant predictors that predict a firm's participation. Notably, the coefficients for firm size (0.0338), research expenditure (0.1172), and export orientation (0.9135) are positive and statistically significant at the 1% level. This suggests that larger firms, those investing heavily in research and development, and those actively exporting are more inclined to be involved in these projects. Conversely, leverage shows a negative association (-0.4134) and significant at 1%, suggesting that companies with lower debt levels are more likely to be transaction party in the project. In addition, estimated coefficients of cash flow (0.3761) and past performance (0.1424) are positively significant at 5% and 1% respectively, highlighting the preference for financially healthy and historically successful firms. The primary industry involvement (0.2614) and host country GDP (0.4151) are positive and statistically significant at the 1% levels. This underscores the selection of firms in resource-rich countries with larger markets.

Crucially, the coefficient for institutional distance ( -0.0085) is negative and significant at 1 %, validating its role as a valid exclusion restriction variable. This finding suggests a higher likelihood of firms being selected as local counterparts in countries with institutional frameworks more similar to China's, supporting theories that institutional congruence reduces the adaptation costs for multinational enterprises, thereby enhancing FDI prospects (Li, Luo & De Vita, 2020; Cezar & Escobar, 2015). Overall, the Wald test demonstrates that the model's performance is

acceptable. The test is highly significant, showing that explanatory variables' coefficients contribute significantly to the model (Heckman, 1979). Moreover, the reported McFadden pseudo-R-squared is 0.23 which indicates a reasonably good model fit.[5]

[5] McFadden (1977) asserts that the rule of thumb for a good McFadden's pseudo-R-squared is usually set between 0.2-0.4.

**Table 3.4 The first stage estimation: whether an African firm is a local counterpart of China's infrastructure project**

| VARIABLES | Dependent variable<br>Prob (Counterpart =1) |
|---|---|
| *Firm size* | 0.0338*** |
| | (0.0025) |
| *Research expenditure* | 0.1172*** |
| | (0.0267) |
| *Sales growth* | -0.0132 |
| | (0.0323) |
| *Leverage* | -0.4134*** |
| | (0.1086) |
| *Cashflow* | 0.3761*** |
| | (0.0433) |
| *Past performance* | 0.1424** |
| | (0.0569) |
| *Export orientation* | 0.9135*** |
| | (0.0487) |
| *Primary* | 0.2614*** |
| | (0.0482) |
| *GDP per capita* | 0.4151*** |
| | (0.0334) |
| *Institutional distance* | -0.0085*** |
| | (0.0020) |
| *Covid effect* | -0.2165** |
| | (0.1012) |
| Constant | 3.5227*** |
| Year dummy | Yes |
| Industry dummy | Yes |
| Country dummy | Yes |
| Pseudo $R^2$ | 0.23 |
| Wald $X^2$ | 791.98*** |
| Observations | 6036 |

This table presents the results of a Probit estimation. The dependent variable indicates whether an African firm is a local partner in a Chinese infrastructure project. All explanatory and control variables have a one-year lag. The analysis includes year, industry, and country dummies. Robust standard errors are shown within parentheses. The model's overall performance is assessed using the Wald test Chi-squared and pseudo-R-squared values. For details on the definitions and measurements of the variables, refer to the Appendix. Statistical significance is denoted by ***, **, and *, corresponding to 1%, 5%, and 10% respectively.

### 3.4.2 Impact of Chinese Infrastructure Investment on the Performance of the involved African Firms

Next, we estimate the outcome equation (model 2)) by using the three firm performance indicators under study (MVA, ROA, and LP) and reveal the findings in columns (1), (2), and (3) of Table 3.4, respectively. Our findings reveal a nuanced picture of these impacts. Notably, infrastructure investment (INFRA) does not significantly influence ROA and LP, indicating that involvement with Chinese state-owned enterprises (SOEs) does not directly enhance the accounting performance of these African firms. This absence of significant impact on ROA and LP suggests that, contrary to expectations, the productivity spillover effect hypothesized to benefit local firms through technology transfer or management expertise is not realized in this context. This aligns with the observational research findings of Adisu and Sharkey (2010) and Klaver and Trebilcock (2011), who noted that technology transfer, skill development, and employment benefits from Chinese investments in Africa may be negligible.

Conversely, the impact of infrastructure investment on MVA is positive and significant at 1% level (coefficient = 0.1087), underscoring a substantial enhancement in stock market valuation for firms participating as local counterparts in Chinese projects. This supports the signaling effect hypothesis, suggesting that the stock market positively perceives the selection of local firms for these projects, possibly as an endorsement of their future prospects.

The control variables also provide interesting insights. Firm size consistently enhances performance across all metrics, indicating the fundamental advantage of scale in

firm operations. Meanwhile, the negative coefficient associated with leverage, which is significant at the 1% level for market value added (MVA), suggests that high debt levels may undermine firm performance, possibly due to increased financial risk and costs. Cash flow's positive association with ROA and MVA (significant at the 1% level) underscores the significance of liquidity for operational success and market valuation. Notably, the non-significant effect of research expenditure on productivity metrics implies a potential gap in the firms' absorptive capacity, limiting their capacity to leverage external investments for internal innovation and efficiency gains. This aligns with Fuentes and Mies (2021), who argue that absorptive capacity is essential for realizing productivity spillovers from external investments.

The substantial adverse effects of the COVID-19 pandemic across all performance metrics underscore the widespread economic disturbances triggered by global health emergencies, thereby adding complexity to the dynamics of international investments and corporate performance. Moreover, the significance of the IMR in all models validates the occurrence of sample selection bias and supports the use of the Heckman two-stage model for this analysis.

In summary, the mixed results on the effect of China's infrastructure investments on the performance of involved African companies illustrate the complex interplay between tangible operational outcomes and intangible market perceptions. The non-significant results for ROA and LP underscore the complexity of deriving tangible operational benefits from external infrastructure investments. It suggests that such engagements may not immediately translate into operational efficiencies or productivity gains, possibly due to challenges in technology transfer, differences in corporate culture, or the firms' existing

capabilities. This highlights the significance of considering the firms' absorptive capacity when evaluating the potential advantages of foreign investments. Conversely, the positive significant effect on MVA suggests that the strategic value of participating in international infrastructure projects extends beyond immediate financial returns to influence market perceptions and investor confidence.

**Table 3.5 China's infrastructure investment and the performance of the involved African firms**

| VARIABLES | (1)<br>Return on assets | (2)<br>Labour productivity | (3)<br>Market value added |
|---|---|---|---|
| *Infrastructure investment* | 0.0661 | 1.4164 | 0.1087*** |
| | (0.0240) | (0.8369) | (0.0283) |
| *Firm size* | 0.0031*** | 0.0235*** | 0.0033*** |
| | (0.0010) | (0.0068) | (0.0010) |
| *Research expenditure* | 0.0092 | 0.1782 | 0.0058 |
| | (0.0078) | (0.0546) | (0.0079) |
| *Sales growth* | 0.0084** | 0.1128* | 0.0141 |
| | (0.0105) | (0.0604) | (0.0086) |
| *Leverage* | -0.2828*** | -0.3535* | -0.1854*** |
| | (0.0336) | (0.2008) | (0.0364) |
| *Cashflow* | 0.1140*** | 0.0490 | 0.0953*** |
| | (0.0176) | (0.1056) | (0.0311) |
| *Export orientation* | 0.0238** | 0.7501*** | 0.0556*** |
| | (0.0203) | (0.1228) | (0.0186) |
| *Covid effect* | -0.5592*** | -0.5227*** | -0.7492*** |
| | (0.0238) | (0.1487) | (0.0249) |
| *IMR* | 0.0635*** | 0.5747*** | 0.0315** |
| | (0.0201) | (0.1267) | (0.0209) |
| Constant | 0.0369 | 6.5587*** | 0.1293** |
| | (0.0442) | (0.2898) | (0.0517) |
| Year dummy | Yes | Yes | Yes |
| Industry dummy | Yes | Yes | Yes |
| Country dummy | Yes | Yes | Yes |
| Observations | 612 | 612 | 612 |
| R-squared | 0.343 | 0.250 | 0.399 |

Note: This table presents the results from the second stage of the Heckman regression analysis. The dependent variables analysed include return on assets (ROA), labour productivity, and market value added. The main independent variable examined is the size of infrastructure investment. All variables on the right-hand side are lagged by one year. The inverse Mills ratio, derived from the Probit regression, is incorporated. Adjustments for year, industry, and country specifics are included. In parentheses are the robust standard errors. Definitions and measurements of variables are detailed in the Appendix. Significance levels of ***, **, and * correspond to 1%, 5%, and 10%, respectively.

### 3.4.3 Moderating effect of corporate governance: Chinese ownership and Chinese director

In this section (Table 6 and 7), we delve into the moderating effects of corporate governance, particularly through Chinese ownership and directorship within African firms involved in Chinese infrastructure projects. Drawing on resource dependence theory and the resource-based view, we hypothesize that significant involvement of Chinese investors in corporate governance could enhance the resource inflow from Chinese state-owned enterprises (SOEs), potentially benefiting the performance of African firms (Hypothesis 3a). Conversely, we also consider the possibility of increased agency conflicts due to this involvement (Hypothesis 3b), making the net effect an empirical question.

Our analysis, leveraging interactive terms between China's infrastructure investment and corporate governance indicators, sheds light on these dynamics. The estimation results, when considering Chinese ownership as a proxy for corporate governance, reveal that the direct effect of infrastructure investment (INFRA) on accounting performance metrics (ROA and LP) remains statistically insignificant. However, the positive and significant coefficient for INFRA in relation to market value added (statistically significant at the 5% level, coefficient = 0.0582) confirms the stock market's positive response to such corporate ties, echoing the signaling effect posited in Hypothesis 2. Furthermore, Chinese ownership itself positively affects firm performance, with a particularly strong signaling effect noted in the market value added (significant at the 5% level, coefficient = 0.3823 for the interaction term INFRA*Ownership), supporting Hypothesis 3a that posits a beneficial impact from Chinese corporate governance involvement on firm valuation.

When evaluating the presence of Chinese directors as a corporate governance measure, similar patterns emerge for infrastructure investment's influence on market valuation, albeit with a notable twist. While the direct effect of INFRA remains insignificant for ROA and LP, its positive significance for market value added is reaffirmed (significant at the 5% level, coefficient = 0.1320). Yet, the presence of Chinese directors appears to negatively impact accounting performance measures, suggesting potential agency conflicts (significant at the 5% level for Director in ROA and LP), thus lending support to Hypothesis 3b. Moreover, the interaction between INFRA and Chinese director adversely affects labor productivity (significant at the 10% level, coefficient = -0.0008), further underscoring the complexities of governance involvement in operational outcomes.

These findings highlight the nuanced impacts of Chinese corporate governance involvement on African companies' performance via infrastructure projects. While market valuations tend to benefit, potentially due to enhanced perceptions of legitimacy and resource access, the direct impact on operational efficiency and productivity remains contested, reflecting the dual forces of resource provision and potential governance challenges. This analysis extends the discourse on international corporate governance's impact, emphasizing the need for a balanced approach that navigates the benefits of foreign investment and governance involvement against the backdrop of possible internal conflicts and operational inefficiencies.

**Table 3.6 China's infrastructure investment and the performance of the involved African firms: moderating effect of Chinese ownership**

| VARIABLES | (1) Return on assets | (2) Labour productivity | (3) Market value added |
|---|---|---|---|
| *Infrastructure inv. (INV)* | 0.0503 | 0.0127 | 0.0582** |
| | (0.0350) | (0.0167) | (0.0859) |
| *INV * Ownership* | 0.1034 | 0.0536 | 0.3823** |
| | (0.0573) | (0.0314) | (0.1615) |
| *Ownership* | 0.0255* | 0.0054** | 0.6330*** |
| | (0.0609) | (0.0429) | (0.1955) |
| *Firm size* | 0.0028*** | 0.0022*** | 0.0041** |
| | (0.0009) | (0.0006) | (0.0033) |
| *Research expenditure* | -0.0091 | 0.0121 | 0.1250 |
| | (0.0065) | (0.0045) | (0.0237) |
| *Sales growth* | 0.0149* | 0.0003 | 0.0729*** |
| | (0.0088) | (0.0062) | (0.0267) |
| *Leverage* | -0.0048 | -0.0954*** | -0.8840*** |
| | (0.0277) | (0.0196) | (0.1152) |
| *Cashflow* | -0.0147 | 0.0200** | 0.1423** |
| | (0.0277) | (0.0098) | (0.0559) |
| *Export orientation* | 0.0427*** | 0.0628*** | 0.3140*** |
| | (0.0152) | (0.0113) | (0.0649) |
| *Covid effect* | -0.4124*** | -0.2770*** | -3.2495*** |
| | (0.0207) | (0.0131) | (0.0874) |
| *IMR* | 0.0060* | -0.0424*** | 0.5131*** |
| | (0.0180) | (0.0111) | (0.0587) |
| Constant | -0.3540*** | 0.4421*** | 8.1155*** |
| | (0.0441) | (0.0255) | (0.1386) |
| Year dummy | Yes | Yes | Yes |
| Industry dummy | Yes | Yes | Yes |
| Country dummy | Yes | Yes | Yes |
| Observations | 612 | 612 | 612 |
| R-squared | 0.225 | 0.211 | 0.370 |

Note: This table presents the results from the second stage of a Heckman regression analysis. The variables analyzed for their impact include return on assets, labour productivity, and market value added. Infrastructure investment is defined as the proportion of Chinese investment in the current year's project relative to total Chinese infrastructure investments in Africa for the same year. The Inverse Mills Ratio (IMR), derived from the Probit model (model 1), is included. Control variables such as year, industry, and country dummies are incorporated, with a one-year lag applied to all independent variables. Robust standard errors are provided in parentheses. For definitions and measurements of variables, refer to the Appendix. Significance levels are indicated by ***, **, and *, corresponding to 1%, 5%, and 10%, respectively.

**Table 3.7 China's infrastructure investment and the performance of the involved African firms: moderating effect of Chinese director**

| VARIABLES | (1) Return on assets | (2) Labour productivity | (3) Market value added |
|---|---|---|---|
| *Infrastructure inv. (INV)* | 0.0495 | 0.2898 | 0.1320** |
| | (0.2681) | (0.4668) | (0.1184) |
| *INV * Director* | 0.4517 | -0.0008* | -0.1690 |
| | (0.4958) | (0.4249) | (0.1207) |
| *Director* | -0.1649** | -0.0285** | 0.1068 |
| | (0.0581) | (0.3615) | (0.0989) |
| *Firm size* | 0.0028*** | -0.0045 | 0.0027** |
| | (0.0008) | (0.0033) | (0.0010) |
| *Firm age* | 0.0071 | 0.1234 | 0.0117 |
| | (0.0066) | (0.0236) | (0.0079) |
| *Sales growth* | 0.0146 | 0.0748*** | -0.0081 |
| | (0.0089) | (0.0269) | (0.0106) |
| *Leverage* | -0.0049 | -0.8862*** | -0.2851*** |
| | (0.0276) | (0.1153) | (0.0337) |
| *Cashflow* | -0.0120 | 0.1517*** | 0.1238*** |
| | (0.0285) | (0.0549) | (0.0174) |
| *Export orientation* | 0.0393*** | 0.3046*** | 0.0294 |
| | (0.0151) | (0.0638) | (0.0202) |
| *Covid effect* | -0.4166*** | -3.2705*** | -0.5658*** |
| | (0.0187) | (0.0874) | (0.0238) |
| *IMR* | 0.0042 | 0.5054*** | 0.0647*** |
| | (0.0180) | (0.0580) | (0.0201) |
| Constant | -0.3542*** | 8.1537*** | 0.0655 |
| | (0.0466) | (0.1336) | (0.0434) |
| Year dummy | Yes | Yes | Yes |
| Industry dummy | Yes | Yes | Yes |
| Country dummy | Yes | Yes | Yes |
| Observations | 612 | 612 | 612 |
| R-squared | 0.228 | 0.391 | 0.342 |

Note: This table presents the results from the second stage of a Heckman regression analysis. The variables analyzed for their impact include return on assets, labour productivity, and market value added. Infrastructure investment is defined as the proportion of Chinese investment in the current year's project relative to total Chinese infrastructure investments in Africa for the same year. The Inverse Mills Ratio (IMR), derived from the Probit model (model 1), is included. Control variables such as year, industry, and country dummies are incorporated, with a one-year lag applied to all independent variables. Robust standard errors are provided in parentheses. For definitions and measurements of variables, refer to the Appendix. Significance levels are indicated by ***, **, and *, corresponding to 1%, 5%, and 10%, respectively.

### 3.4.4 Robustness test

To ensure the reliability of our findings presented in Tables 3.4, 3.5, 3.6, and 3.7, we apply the average treatment effect (ATE) model developed by Heckman and Manning, which is also to avoid sample selection problems and control for endogeneity (Heckman, 1976, 1978; Manning, 2004). Here, we estimate both the treatment equation (1) and the outcome equation (2) at the same time by using the full information maximum likelihood procedure. This is because the error terms ($u_{it}$ $and$ $\varepsilon_{it}$) are assumed to follow a bivariate normal distribution (Heckman, 1978). Meanwhile, in the treatment effect model, we use adummy variable (*counterpart =1*) as the proxy for firm interaction to indicate whether a local firm is the host country counterpart of China's infrastructure projects. Hence, the outcome equation (7) with the probability of receiving the treatment (equation (6)) is as follows:

$$Counterpart_{it} = \alpha_0 + \alpha_1 SIZE_{it-1} + \alpha_2 R\&D_{it-1} + \alpha_3 SG_{it-1}\ \alpha_4 LEV_{it-1} + \alpha_5 CF_{it-1} + \alpha_6 EX_{it-1} + \alpha_7 PP_{it-1} + \alpha_8 PRI_{it-1} + \alpha_9 GDP_{it-1} + \alpha_{10} COVID_{t-1}\ \alpha_{10} INST_{it-1} + \mu_{it} \quad (6)$$

$$Perform_{it} = \beta_0 + \beta_1 \widehat{Counterpart}_t + \beta_2 SIZE_{it-1} + \beta_3 R\&D_{it-1} + \beta_4 SG_{it-1} + \beta_5 LEV_{it-1} + \beta_6 CF_{it-1} + \beta_7 EX_{it-1}\ \beta_8 COVID_{t-1} + \varepsilon_{it} \quad (7)$$

The treatment model (in Table 3.8) reveals that the institutional distance between the recipient and China (*INST)*, used as an instrumental variable, significantly influences the likelihood of a firm becoming a local counterpart, with a negative coefficient (significant at the 1% level). This suggests a tendency for investments in countries that have institutional frameworks similar to those in China, consistent with previous research that emphasises the importance of institutional similarity in promoting international investments (Deng, Jean, & Sinkov, 2018).

The outcome model's results provide nuanced insights into the effect of these investments on the performance of the companies. Notably, while estimated coefficient for being a local counterpart (Counterpart) significantly positively affects market value added (significant at the 1% level, coefficient = 0.5158), it does not show a significant impact on return on assets (ROA) or labor productivity (LP). This discrepancy underscores a signaling effect where market valuation benefits from the involvement in Chinese projects, but such involvement does not translate into direct operational or productivity improvements. The non-significance results for ROA and LP implies that, despite potential market benefits, the operational efficiency and productivity spillovers from these investments are not realized, possibly due to limitations in the local firms' absorptive capacities.

**Table 3.8 China's infrastructure investment and the performance of Listed firms: ATE result**

| | | Outcome Model | | |
|---|---|---|---|---|
| VARIABLES | (1) Treatment Model | (2) Return on assets | (3) Labour productivity | (4) Market value added |
| *Counterpart* | | 0.7261 | 0.5513 | 0.5158*** |
| | | (0.1233) | (0.0503) | (0.0528) |
| *Firm size* | 0.0297*** | 0.0152*** | 0.0083*** | 0.0063*** |
| | (0.0027) | (0.0031) | (0.0010) | (0.0010) |
| *Research expenditure* | 0.0713*** | 0.0440* | -0.0122 | -0.0055 |
| | (0.0264) | (0.0227) | (0.0080) | (0.0076) |
| *Sales growth* | -0.0357 | 0.0532* | -0.0129 | 0.0152* |
| | (0.0310) | (0.0274) | (0.0103) | (0.0092) |
| *Leverage* | -0.3362*** | 0.0303 | 0.0113 | -0.0012 |
| | (0.0962) | (0.0475) | (0.0170) | (0.0031) |
| *Cashflow* | 0.6957*** | 0.1576*** | -0.0131 | 0.1035*** |
| | (0.0613) | (0.0539) | (0.0174) | (0.0308) |
| *Export orientation* | 0.5506*** | 0.0608 | 0.0447*** | 0.0769*** |
| | (0.0592) | (0.0480) | (0.0162) | (0.0117) |
| *Covid effect* | -0.0306 | -3.3043*** | -0.5757*** | -0.3532*** |
| | (0.0872) | (0.0797) | (0.0221) | (0.0212) |
| *Primary* | 0.5983*** | | | |
| | (0.0527) | | | |
| *Past performance* | 0.1459*** | | | |
| | (0.0549) | | | |
| *Gross domestic product* | 0.1736*** | | | |
| | (0.0327) | | | |
| *Institutional distance* | -0.0089*** | | | |
| | (0.0016) | | | |
| Constant | 1.6105*** | 0.9936*** | -0.2219*** | -0.5901*** |
| | (0.2629) | (0.1341) | (0.0447) | (0.0663) |
| Year dummy | | Yes | Yes | Yes |
| Industry dummy | | Yes | Yes | Yes |
| Country dummy | | Yes | Yes | Yes |
| Wald test of independent of equation $p>x^2$ | | 69.28*** | 94.91*** | 61.82*** |
| Observations | 6,039 | 6,039 | 6,039 | 6,039 |

Note: This table presents the results for the Average Treatment Effect. The dependent variables analyzed include return on assets (ROA), labour productivity, and market value added. The primary independent variable is binary, representing the interaction between Chinese and African firms, assigned a value of 1 for interaction and 0 otherwise. All variables on the right-hand side of the equation are lagged by one year. The fit of the model is evaluated using the Wald test, with the p-value provided in parentheses. Year, industry, and country controls are included. Robust standard errors are indicated in parentheses. The appendix contains detailed descriptions and measurements of the variables. Significance levels of 1%, 5%, and 10% are marked with ***, **, and *, respectively.

Furthermore, the findings from Tables 3.9 and 3.10, which examine the moderating impacts of Chinese directorship and ownership, reinforce the complexity of the governance involvement's impact. While Chinese ownership enhances market valuation, indicating a positive market response to such governance ties, the presence of Chinese directors appears to negatively impact labor productivity, pointing to potential agency conflicts. This dual outcome highlights the intricate dynamics at play in the governance of African firms involved in Chinese infrastructure projects, reflecting both the opportunities for market enhancement and the challenges in achieving operational efficiency gains.

We observed that the p-value associated with the test of independent equations is significant in all models, which indicates that sample selection bias has been corrected. Thus, it justifies using the ATE model, and the model performance is acceptable.

In summary, the robustness checks affirm the primary findings from earlier analyses, while highlighting the importance of China's infrastructure investments in influencing the market valuation of African firms through a signaling effect. However, the absence of significant impacts on operational performance measures calls for a deeper investigation into the mechanisms through which these investments affect firm outcomes. The insights from this analysis contribute to the broader discourse on the conditional effectiveness of foreign investments and governance involvement in driving local firm performance, emphasizing the need for a nuanced understanding of these dynamics.

**Table 3.9 China's infrastructure investment and the performance of the involved African firms: moderating effect of Chinese ownership: ATE results**

| | | Outcome model | | |
|---|---|---|---|---|
| VARIABLES | (1) Treatment model | (2) Return on assets | (3) Labour productivity | (4) Market value added |
| *Counterpart (C)* | | 0.2384*** | 0.4657*** | 0.7511*** |
| | | (0.0463) | (0.0405) | (0.1344) |
| *C * Ownership* | | 0.1217* | -0.0509 | 0.3057* |
| | | (0.0678) | (0.0418) | (0.1617) |
| *Ownership* | | 0.0542 | 0.0825 | 0.6400*** |
| | | (0.0729) | (0.0612) | (0.1962) |
| *Firm size* | 0.0297*** | 0.0017* | 0.0022*** | 0.0156*** |
| | (0.0027) | (0.0009) | (0.0008) | (0.0031) |
| *Research expenditure* | 0.0713*** | 0.0014 | 0.0017 | 0.0451** |
| | (0.0264) | (0.0075) | (0.0071) | (0.0228) |
| *Sales growth* | -0.0357 | 0.0100 | 0.0106 | 0.0514* |
| | (0.0310) | (0.0085) | (0.0093) | (0.0274) |
| *Leverage* | -0.3362*** | -0.0070 | 0.0024 | 0.0302 |
| | (0.0962) | (0.0124) | (0.0025) | (0.0473) |
| *Cashflow* | 0.6957*** | 0.0640** | 0.0937*** | 0.1640*** |
| | (0.0613) | (0.0258) | (0.0143) | (0.0540) |
| *Export orientation* | 0.5506*** | 0.0370*** | 0.0081 | 0.0576 |
| | (0.0592) | (0.0139) | (0.0132) | (0.0482) |
| *Covid effect* | -0.0306 | -0.7849*** | -0.3509*** | -3.2856*** |
| | (0.0872) | (0.0213) | (0.0162) | (0.0802) |
| *Primary* | 0.5983*** | | | |
| | (0.0527) | | | |
| *Past performance* | 0.1459*** | | | |
| | (0.0549) | | | |
| *GDP per capita* | 0.1736*** | | | |
| | (0.0327) | | | |
| *Institutional distance* | -0.0089*** | | | |
| | (0.0016) | | | |
| Constant | 1.6105*** | 0.0368 | -0.5353*** | 7.9788*** |
| | (0.2629) | (0.0488) | (0.0373) | (0.1344) |
| Year dummy | | Yes | Yes | Yes |
| Industry dummy | | Yes | Yes | Yes |
| Country dummy | | Yes | Yes | Yes |
| Wald test of independent of equation $p>x^2$ | | 11.40*** | 91.03*** | 69.97*** |
| Observations | 6,039 | 6,039 | 6,039 | 6,039 |

Notes: This table reports the Average treatment effect results. The dependent variables are return on assets (ROA), labour productivity, and market value added. The primary explanatory variable is Counterpart, a dummy variable that takes 1 for the China-Africa firm's interaction, otherwise zero. All variables on the right-hand side of the equation are lagged by one year. As model fit, the Wald test is reported with its p-value in parenthesis. Year, industry, and country dummies are added.

**Table 3.10 China's infrastructure investment and the performance of the involved African firms: moderating effect of Chinese director: ATE result**

| | | Outcome model | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | Treatment Model | Return on assets | Labour productivity | Market value added |
| *Counterpart* | | 0.2193*** | 0.5585*** | 0.6632*** |
| | | (0.0380) | (0.0499) | (0.1264) |
| *Counterpart * Director* | | -0.8337 | -0.1786* | -0.4131 |
| | | (0.5821) | (0.1043) | (0.8620) |
| *Director* | | -0.0879 | -0.1097* | 0.6871*** |
| | | (0.0725) | (0.0873) | (0.1203) |
| *Firm size* | 0.0297*** | 0.0019** | 0.0082*** | 0.0155*** |
| | (0.0027) | (0.0009) | (0.0010) | (0.0031) |
| *Research expenditure* | 0.0713*** | 0.0029 | -0.0117 | 0.0353 |
| | (0.0264) | (0.0076) | (0.0080) | (0.0229) |
| *Sales growth* | -0.0357 | 0.0102 | -0.0129 | 0.0565** |
| | (0.0310) | (0.0085) | (0.0103) | (0.0274) |
| *Leverage* | -0.3362*** | -0.0069 | 0.0112 | 0.0305 |
| | (0.0962) | (0.0123) | (0.0168) | (0.0478) |
| *Cashflow* | 0.6957*** | 0.0653** | 0.0118 | 0.1460*** |
| | (0.0613) | (0.0263) | (0.0173) | (0.0541) |
| *Export orientation* | 0.5506*** | 0.0349** | 0.0450*** | 0.0659 |
| | (0.0592) | (0.0140) | (0.0162) | (0.0480) |
| *Covid effect* | -0.0306 | -0.7914*** | -0.5772*** | -3.2961*** |
| | (0.0872) | (0.0216) | (0.0221) | (0.0799) |
| *Primary* | 0.5983*** | | | |
| | (0.0527) | | | |
| *Past performance* | 0.1459*** | | | |
| | (0.0549) | | | |
| *GDP per capita* | 0.1736*** | | | |
| | (0.0327) | | | |
| *Institutional distance* | -0.0089*** | | | |
| | (0.0016) | | | |
| Constant | 1.6105*** | 0.5850* | -0.2200*** | 7.9682*** |
| | (0.2629) | (0.3431) | (0.0449) | (0.1343) |
| Year dummy | | Yes | Yes | Yes |
| Industry dummy | | Yes | Yes | Yes |
| Country dummy | | Yes | Yes | Yes |
| Wald test of independent of equation $p>x^2$ | | 10.87*** | 94.45*** | 68.91*** |
| Observations | 6,039 | 6,039 | 6,039 | 6,039 |

Notes: This table reports the Average treatment effect results. The dependent variables are return on assets (ROA), labour productivity, and market value added. The primary explanatory variable is Counterpart, a dummy variable that takes 1 for the China-Africa firm's interaction, otherwise zero. All variables on the right-hand side of the equation are lagged by one year. As model fit, the Wald test is reported with its p-value in parenthesis. Year, industry, and country dummies are added.

### 3.4.5 Further Evidence on the Signaling Effect

In further exploring the signaling effect, we analyze the stock market reaction to the participation of 51 African firms in Chinese infrastructure projects through a simple event study. This research explores the stock market's reaction to the official commencement of these projects, utilizing the Capital Asset Pricing Model (CAPM) to predict expected returns from historical stock prices and market indices. By comparing these expected returns to the actual returns on the event date, we calculate the abnormal returns, offering insights into the market's perception of these firms' involvement in the projects.

The event study's results (in Table 3.11) reveal that 39 out of the 51 firms (approximately 76%) have statistically significant abnormal returns on the event date. This suggests that the market responds favourably to the firms' participation in Chinese infrastructure projects. This phenomenon underscores a robust signaling effect where market participants interpret the participation in such projects as indicative of promising prospects for the involved African firms. This positive market reaction is consistent with the theoretical underpinning that involvement in significant infrastructure projects reduces informational asymmetry and enhances firm valuation, as suggested by existing literature on signaling in financial markets.

Conversely, a few firms experienced negative abnormal returns, suggesting that the market might have concerns about certain projects or the specifics of the firms' involvement. These mixed reactions provide a nuanced understanding of the signaling effect, indicating that while general market sentiment towards Chinese-African firm collaborations is positive, investor perceptions can vary based on project specifics, firm capabilities, and perhaps the perceived risks associated with certain investments.

The overall positive abnormal returns lend empirical support to the signaling theory, suggesting that the market views these collaborations as value-enhancing for the African firms involved. However, the variability in responses also highlights the complexity of market perceptions and the multifaceted nature of signaling effects.

This evidence of a signaling effect further substantiates our earlier findings that stock market valuation, rather than direct accounting performance improvements, benefits most from the involvement of African firms in Chinese infrastructure projects. It adds a layer of empirical insight into how market perceptions of corporate actions, especially in the context of international collaborations, can significantly influence firm valuation, providing a richer understanding of the dynamics at play in China-Africa infrastructure engagements.

**Table 3.11 Stock market reaction to the involvement of local African firms in China's infrastructure projects**

| Firms name | Infrastructure project | Event date | Abnormal Return (AR) | T-Test |
|---|---|---|---|---|
| AECI Ltd | Modderfontein New City Development and Heartland Propertydevelopment | 5-Nov-13 | 1.99% | 2.15** |
| Wesizwe Platinum Limited | Bakubung Mine | 24-May-10 | 8.80% | 3.77*** |
| Assore Ltd | Khumani Iron Ore Mine | 27-Sep-10 | 10.09% | 2.95** |
| Mustek Ltd | Cloud Computing and Data Center in South Africa | 28-Feb-14 | 4.95% | 2.83*** |
| Super group | Platreef Palladium Platinum Nickel Copper Gold Development | 7-Apr-10 | 4.18% | 2.10** |
| Telekom SouthAfrica SOC ltd | Ultra-Broadband Access Network and Livestream Project from Boulder Beach in Cape Town | 5-Jul-10 | 0.33% | 0.27 |
| Anglo American Platinum Ltd | Bokoni Mine | 20-Dec-13 | 3.99% | 2.31** |
| African Rainbow Minerals Ltd | Khumani Expansion Project | 18-Jun-13 | -0.12% | -0.07 |
| PSG Konsult Ltd | Black Empoerment Platreef Palladium Project with Tangshan Jidong Cement | 14-May-12 | 2.55% | 2.01** |
| CSG Holdings Ltd | Civil Defence Partnership in South Africa | 2-Feb-10 | 9.00% | 1.95** |
| MTN Group Ltd | Internet Of Things Platform and Multi-Gigabit Mobile Connection Solution | 10-May-17 | 1.86% | 1.08 |
| Marenica energy | Marenica Uranium Project | 19-Dec-11 | -11.00% | -1.80* |
| Gold Fields Ltd | Ivanhoe Mine and Goldfield Exploration of Gold | 6-Jul-10 | -4.41% | -2.75*** |
| MC Mining Ltd | Baobab Mining Development | 7-Dec-15 | 15.22% | 2.76*** |
| Kumba Iron Ore Ltd | Platreef Palladium Platinum Nickel Copper Gold Development | 4-Nov-10 | -4.01% | -2.91*** |
| Vodacom | Dual Carrier High Speed Uplink Packet Access (Dc-Hsupa) Solution in South Africa | 10-Nov-10 | 2.06% | 2.15** |
| Sasol | Platreef Palladium Platinum Nickel Copper Gold Development and First Automative Wors Factory in Port Elizabeth | 29-Mar-10 | 2.20% | 1.96** |
| Calgro M3 Holdings Ltd | Tanganani Ext 14 | 5-Jan-13 | 2.57% | 0.25 |
| Advtech Ltd | Establishment Of Founders Hill College in Modderfontein | 4-Oct-13 | 5.32% | 2.52** |
| A-Cap energy | Letlhakane Uranium Project in Bostwana | 7-Apr-10 | 4.94% | 1.08 |
| Shumba Energy | Coal-To-Liquid Plant in Botswana | 6-Jun-17 | 12.85% | 2.38** |
| Dangote Cement PLC | Us$ 4.34 billion Cement Plants and Us$ 100 million Truck Plant In Nigeria | 19-Aug-15 | 1.77% | 1.99** |
| BUA Cement | Construction Of Steel Plant in Nigeria | 4-Jan-16 | 4.16% | 1.09 |
| Total Nig PLC | Oil Bloc Agreement with Sinopec | 23-Sep-13 | 9.26% | 2.29** |

| Firms name | Infrastructure project | Event date | Abnormal Return (AR) | T-Test |
|---|---|---|---|---|
| Mtech | Development Of Wireless Router with Huawei | 20-Nov-12 | -8.74% | -3.23*** |
| MTN Nigeria Communications Ltd | Commercial Deployment of Rural Star 2.0 | 15-Aug-10 | 4.06% | 2.03** |
| Total Cote d'Ivoire SA | Lake Albert Development Project | 21-Dec-10 | 6.37% | 2.89*** |
| Onatel SA | Building Of Fiber Networks in Burundi and ONAMOB Network Modernization | 23-Oct-14 | -6.11% | -3.28*** |
| Orascom Development Egypt SAE | Assuit Power Plant and Transformer Substations In Egypt | 28-Jun-16 | 7.73% | 0.80 |
| Telecom Egypt Co SAE | Cloud Computing System Via Telecom Egypt Data Centers | 27-Sep-10 | 2.23% | 2.18** |
| Total Senegal SA | Electric Mobility Venture and Lake Albert Development Project | 16-Dec-10 | 5.26% | 2.04** |
| MTN Ghana | Rural Star Solution in Ghana | 29-Jan-10 | 2.96% | 1.63 |
| Tullow Oil | Lake Albert Rift Basin and Exploration Areas 1,2 And 3a Development in Uganda | 7-Jul-10 | 1.90% | 0.93 |
| Sonatel | Global Network Operation in Senegal, Abidjan, and Dakar | 21-Dec-16 | 2.78% | 2.59*** |
| Maroc telecom | End-To-End Internet Protocol Television in Morocco | 15-Oct-10 | 1.35% | 2.31** |
| Societe Cellcom SA | Launch Of Huawei Ft 2260 Network Solution | 5-Sep-16 | 3.07% | 2.40** |
| Les cements de Bizerte | Cement Plant Deal with China National Building Material | 22-Nov-10 | -2.78% | -2.34** |
| Acacia Mining Plc | Bulyanhulu, Buzwagi and North Mara Mines Deal with Shadong Gold Mining Company | 11-May-17 | 2.16% | 0.64 |
| Econet Wireless Zimbabwe Ltd | Launch Of Huawei CPE- B3- 15 Wireless Router | 28-Feb-10 | 2.34% | 1.39 |
| Bindura Nickel Corp Ltd | Nickel Production with China Railway Engineering | 21-Nov-12 | 4.42% | 3.87*** |
| Airtel Networks Zambia PLC | Network Virtualization Reconstruction Project and Digital Transformation of Voice Network in Africa | 10-Aug-17 | 6.22% | 3.77*** |
| Vivo Energy Mauritius Ltd | Soroti Lira Highway in Uganda | 1-Nov-16 | -2.17% | -2.54** |
| Lafarge Cement Zambia Plc | Langer Heinrich Project with Cement Production Lines Near Lusaka | 14-Nov-18 | -23.83% | -6.49*** |
| Telekom Networks Malawi Ltd | Development Of Cloud Core Network in Malawi | 21-Oct-16 | -7.79% | -2.47** |
| ZCCM Holding | Development Of Cement Plantin Masaiti and Thermal Power Plant; | 26-Feb-10 | 8.44% | 2.33** |
| Paladin energy | Paladin Energy Uranium Mine in Namibia | 20-Jan-14 | 12.30% | 3.12*** |
| ARM Cement Plc | Us$ 11.6 million Deal for Maweni Limestone | 4-Sep-17 | -1.43% | -2.67*** |
| KENGEN | Steam Field Development at Olkaria 1 And IV in Kenya | 16-Aug-13 | 0.61% | 1.73* |

| Firms name | Infrastructure project | Event date | Abnormal Return (AR) | T-Test |
|---|---|---|---|---|
| Kenya Power | Power Generation Deal with Hexing Technologies Limited | 24-Oct-14 | -1.31% | -3.21*** |
| Total Kenya Ltd | Lake Albert Development Project | 19-Jul-12 | 0.27% | 0.76 |
| Safaricom Plc | Rural Star Solution in Kenya | 30-Jun-14 | 1.01% | 2.55** |

Note: The event date refers to the official commencement date of the infrastructure project. The abnormal returns (AR) represent the difference between the firm's actual stock returns and anticipated returns on the event date. The t-test statistics determine whether the actual stock returns on the event date significantly deviate from the expected returns.

## 3.5 Discussion and Conclusion

In this study, we assess the effect of Chinese infrastructure investments on the performance of African firms, with a particular focus on the signaling effect and its implications for stock market valuation versus the FDI spillover effect. Our empirical findings reveal a nuanced picture: while direct productivity gains for labour productivity and return on assets are not evident, there is a significant positive reaction in the stock market to African firms' involvement in these projects. This reaction suggests a strong signaling effect, where the market views the collaboration with Chinese entities as indicative of future growth potential, thereby reducing information asymmetry and enhancing the demand for these firms' stocks.

Our analysis reveals several policy implications. First, the observed signaling effect underscores the significance of foreign investment as an indicator of credibility and promise for African firms among investors. Policymakers should recognise the value of such international collaborations in bolstering the profile of local firms within financial markets. However, this also calls for careful regulatory oversight to ensure that the positive market perceptions do not lead to speculative bubbles detached from the firms' actual economic fundamentals.

Secondly, the absence of significant productivity spillovers points to a critical gap in absorptive capacity among African firms. This finding suggests a pivotal area for policy intervention: there is a clear need to bolster innovation and research capacities within local firms to maximize the benefits of foreign investments. Enhancing absorptive capacity would not only facilitate productivity gains but also contribute to sustainable economic advancement.

However, it is important to emphasise that although our analysis yields specific policy implications, it does not cover broader aspects, such as the geopolitical and social impacts of Chinese infrastructure investments in Africa. These significant factors are beyond the scope of our research and would necessitate in-depth investigations.

Our research faces some limitations, mainly due to constraints in data availability. We focused our analysis on 51 publicly traded, non-financial African firms participating directly in Chinese infrastructure projects. The absence of data on unlisted companies and government ministries also involved in these projects limits the scope of our study. Including these entities in future studies could yield a more thorough analysis of the effects of Chinese investments in Africa.

In conclusion, while Chinese infrastructure projects in Africa are perceived positively by stock markets, translating this into concrete productivity gains for local firms requires enhancing their absorptive capacities. Future studies could investigate the broader economic and social implications of these investments and extend the analysis to non-listed firms and governmental bodies, contingent upon improved data availability.

# CHAPTER 4
# CHINA'S INFRASTRUCTURE INVESTMENT IN AFRICA: EXPORT PERFORMANCE OF COUNTRIES

## 4.1 Introduction

In recent years, exports from African countries have significantly increased, with China becoming the continent's foremost trading partner (UNCTAD, 2020). Report shows that the average value of African exports to China between 2005 and 2019 ($45,801.17 million) is 14 times greater than the value of exports from 1990 to 2004 ($3,242.85 million) (UNCTAD, 2020). Exports were valued at $20,573.02 million in 2005 and progressively climbed to $60,227.12 million in 2019, three times greater than exports to the Canada, United States and United Kingdom over the same period (International Monetary Fund, 2019). Indeed, China has emerged as a significant market for exports from Africa; this is not surprising given that forty-six (46) African countries (about 83%) are recipients of China's infrastructure investments (China Global Investment Tracker, 2020).

We focus on the relationship between China's infrastructure investments in Africa and the export performance of the recipient countries. This examination is crucial because China's economic interactions with Africa differ significantly from those of traditional donors like the European Union, the United States, the Paris Club, and the United Kingdom, especially regarding trade patterns and private investment structures. As part of the Going Global Strategy, Chinese State-Owned Enterprises (SOEs), backed by the Chinese government, have engaged in what is often described as infrastructure investment. This investment typically involves official development aid, which may include concessionary

loans or resource-for-infrastructure deals (R4I), a strategy commonly adopted by China in its dealings with developing nations (Strange et al., 2013; Brautigam & Gallagher, 2014; Pigato & Tang, 2015). Such strategies have positioned China as a critical player among international investors, drawing considerable global attention.

A thread of research has raised concerns regarding the underlying intentions of China's global economic strategy, suggesting that it may serve as a means to exploit the increasing demand for resources in many markets (Zhang et al., 2013; Amighini et al., 2013). Another perspective is held by certain scholars who argue that it offers a potential solution to address the infrastructure gaps prevalent in developing economies (Mlambo, et al., 2018; Odoom, 2017; Alves, 2013). Critics have raised concerns regarding the underlying motives of this investment and its possible effects on trade, resource allocation, and developing countries' political and economic progress (Kolstad & Wiig, 2011; Busse et al., 2016). Specifically, while the increase in African exports to China has been viewed positively, there are worries about the relationship between Chinese infrastructure investments and the export of primary resources from Africa.

Moreover, scholars have contended that Chinese SOEs have used infrastructure investment in Africa as a ruse to secure mining rights, acquire resource-oriented African companies, and obtain ownership of oil blocs (Witness, 2011; Zhang et al., 2013; Konijn & van Tulder, 2015). A clear example is Guinea's Souapiti Dam, where China Three Gorges Corporation, China International Water Electric, and the Guinean government share ownership and operational responsibilities. This collaboration is closely linked to the region's bauxite mining operations. Furthermore, the China National Petroleum Corporation (CNPC)

has secured a 40% share in the Nile Petroleum Operating Company. In Ghana, the Bui Dam is constructed by the Sinohydro Corporation, which depends on the export of cocoa and other resources for economic viability (Urban et al., 2015; Konijn & van Tulder, 2015). Therefore, Chinese investments in Africa may represent a strategic effort to ensure access to the continent's abundant natural resources, leading to concerns about the potential emergence of a resource curse.

Despite the importance of the aforementioned challenges, most studies (such as Cheung et al., 2014; Kolstad and Wiig 2011; Amighini et al., 2013) concentrate on what motivates Chinese private investment in Africa and seek evidence for resource-seeking and market-seeking motives. However, these studies do not explain how these motivations affect African exports nor focus on China's OII. Furthermore, there has been more systematic research on the impact of Chinese private investment on economic growth in Africa (Kolstad & Wiig, 2011; Busse et al., 2016; Doku et al., 2017; Megbowon et al, 2019; Zhang, 2021). Nonetheless, these studies, as well as a slew of others concentrating on Chinese OII in Africa, are primarily observational (Adisu, 2010; Eberhard et al., 2011; Nechifor et al., 2021), thus indicating the need for experimental evidence on the subject.

Consequently, this study advances beyond prior work by focusing on how China's infrastructure investment could affect African export performance while also considering the motivations behind and the types of these projects. We analyse how this investment affects export performance and consider the resource-for-infrastructure model (RFI deal). The unique nature of the Chinese infrastructure investment springs up the export-oriented investment (RFI deal), where natural resources (such as crude oil, copper, cocoa, and bauxite

among others) are being used to secure infrastructure projects in Africa (Brautigam & Gallagher, 2014). This is to capture the distinct effects of different measures of infrastructure investment on Africans' export to China. This is necessary because concerns about the real benefits surrounding China's infrastructure investments, especially RFI deals in Africa, have been raised.

Furthermore, we develop country-level empirical strategies and use disaggregated industry data to capture the nature of the projects. The behaviour of the aggregate data may obfuscate the unique characteristics of each industry's infrastructure investment on export performance. To our knowledge, studies have not explored Chinese infrastructure investment presence on industries and countries' exports in Africa. This approach would proffer a better understanding of the phenomena under study, which may not be captured using country-level data only. This study's result would proffer policy implications on adopting strategies that will guide the inflow of Chinese infrastructure investment and consider the sustainability of natural resources and market sanity in Africa.

We use panel data from fifty-four (54) African countries and 14 sectors (classified into two industries). We use the Heckman two-stage model and the Generalised Method of Moments, and our findings suggest a synergistic relationship between Chinese infrastructure investment and the export activities of African nations. Specifically, the results for different sectors indicate that the primary industry exhibits complementary effects, whereas the non-primary sectors tend to show substitutability effects. Moreover, our findings suggest that resources for infrastructure act as a complementary link between China's infrastructure investments and African exports to China. More importantly, our results suggest that China's SOEs investments in Africa are resource-seeking in the primary industry while it

is market-seeking in the non-primary industry.

The structure of the remainder of this chapter is as follows: The subsequent section covers the literature review and the development of hypotheses. A detailed description of the data, estimation techniques, and variable measurement follows this. Section 4 shows the empirical findings. The chapter concludes with Section 5.

## 4.2 Theories and Development of Hypotheses

Various theoretical models provide varied analyses of how international capital movements interact with trade, including exports and imports. Understanding the interplay between foreign investment and exports can be enhanced by examining the perspectives of multinational enterprise theory and new trade theory. These approaches suggest that the investment activities of multinational firms are crucial in shaping this dynamic (Markusen, 1995; Help, 1984). Foreign investment may increase the host country's exports through the creation of industrial connections or spillover effects, thereby stimulating demand for local businesses. Conversely, if the strategy focuses on serving the domestic market of the host nation, this could restrict the export of goods.

### 4.2.1 Theory of Multinational Enterprises (MNE)

This theoretical framework underscores the importance of multinational corporations in elucidating the relationship between foreign investment and export activities, as discussed in the works of Markusen (1995; 2002). As globalization progresses, multinational enterprises (MNEs) have become increasingly prominent. To qualify as an MNE, a firm must demonstrate specific advantages related to location, ownership, and internalization (Dunning, 1993). A location advantage refers to the host country’s attributes, like factor

endowments, that attract multinationals. Ownership advantage pertains to possessing intangible assets such as research and development capabilities and managerial expertise, which enable an MNE to compete internationally. Internalization involves the firm's strategic decisions regarding foreign direct investment (FDI) versus other market entry modes like exporting or licensing, influenced by the costs of operating within foreign markets. This also relates to the discussion on substituting these entry modes based on strategic and economic considerations.

To analyze the FDI-exports link, the motivations of the MNE investment activities come into play; it is crucial to consider the motivations behind the investment activities of multinational enterprises (MNEs). The focus here is on the different types of FDI multinationals undertake (Markusen, 1995). When the goal of an MNE is to relocate production to the host country, FDI may reduce exports. Conversely, if the intention is to utilize the host country for exporting resource-based products, FDI can boost exports (Markusen & Venables, 1998; Markusen, 2002). In this scenario, an MNE might delegate part of its production to the host country, using it as a base to export to its home market and other regions (Kutan & Vuksic, 2007).

Consequently, the investment activities of foreign firms play a pivotal role in shaping the export dynamics of the host country. For instance, Onyekwenu et al. (2017) developed a commodity-proximity model to show how MNE investments in West Africa impact exports to the European Union (EU). The study details how MNEs in upstream markets enhance the extraction and processing of intermediate goods, which are subsequently exported to downstream markets in their home countries for further processing. Their findings indicate that FDI boosts the export of primary goods to the EU, characterizing

EU FDI as resource-seeking. Furthermore, Xin and Gyan (2020) explore the factors influencing China-Africa Intra-industry trade (IIT) from 2007 to 2018, discovering a positive correlation between Chinese FDI and IIT. They suggest that Chinese multinationals invest in Africa to capitalize on abundant natural resources and low labour costs, leading to the export of finished products back to China. Thus, the significance of MNE investment activities in host countries is undeniable.

### 4.2.2 New Trade Theory

The New Trade Theory introduces an industrial approach to international trade, suggesting that multinational corporations' strategies elucidate the relationship between foreign investment and trade. According to Horstmann and Markusen (1992), foreign investment might be an alternative to trade when multinationals pursue market-seeking investments. This investment approach often entails multinationals manufacturing identical products in different nations, presuming these nations are similar in various aspects like size, resource endowments, and technological capabilities. Markusen and colleagues (1996) highlight that such investments might influence intra-industry trade activities.

Markusen (1983) discussed the resource-seeking investment model, where foreign investment aims to create export markets by leveraging the host country's resources. Foreign companies may segment their production across multiple countries to optimize costs. Helpman (1984) supported this view, noting differences in the factor intensities of multinational enterprises and factor proportions across countries, which can encourage inter-industry trade between nations. This model also acknowledges the roles of economies of scale, trade barriers, transport costs, competition, and product differentiation in shaping the dynamics between foreign investment and trade.

Empirically, Mukhtarov and colleagues (2019) investigated the impact of FDI on Jordan's exports from 1980 to 2018, noting that economic openness is a cornerstone of Jordan's economic strategy. Their findings support the notion that FDI and exports are complementary. Similarly, Zhang (2021) analyzed the influence of South-South FDI on the African economy using data from 46 African countries from 2003 to 2018. The study found that Chinese FDI not only benefitted African nations more than Northern FDI but also spurred exports and industrialization across the continent. Additionally, Chinese investment in infrastructure was seen as enhancing Africa's capacity to attract foreign investment, thereby fostering economic growth.

At the industry level, Onyekwenu et al., (2017) examined the effect of inward FDI on West African exports to the European Union from 2000 to 2010. Their research differentiated between primary, intermediate, and final goods sectors, revealing a complementary relationship between FDI and the primary sector but a substitutability effect in the intermediate sector. The relationship was insignificant in the final goods sector. They recommended fostering FDI in sectors crucial to industrial development. In another study, Jithin and Suresh (2021) analyzed the effects of FDI across various service sub-sectors in 24 emerging economies from 1999 to 2016. Their findings indicated that while FDI in financial sectors complemented exports, it displaced exports in non-financial sectors, suggesting a need for nuanced sub-sectoral FDI policies. Furthermore, Babatunde (2017) explored the sectoral impacts of inward FDI on Nigeria's exports from 1980 to 2014, finding a positive influence on total exports and exports within the manufacturing, oil, and services sectors but no significant effects on agriculture.

Previous research has broadened our understanding of the relationship between foreign direct investment (FDI) and exports. However, there remains a gap in the literature regarding the impact of infrastructure investment on export performance. Infrastructure investment is becoming increasingly significant in Africa, drawing substantial critique and playing a crucial role in the continent's economic progress. In this context, such investment is often considered FDI, with Chinese multinational corporations either holding equity in projects or acquiring resource-based African companies as part of these ventures (Zhang et al., 2013; Konijn & van Tulder, 2015). The advantages of infrastructure investment often surpass those typically associated with general FDI. This difference stems from the support of Chinese state-owned enterprises (SOEs) by their government, focusing on addressing Africa's critical infrastructure needs essential for sustainable economic growth. Employing multinational enterprise (MNE) and new trade theories helps clarify the activities of Chinese SOEs and their impact on the nexus between infrastructure investment and exports. These theories suggest that cross-border investments and exports can complement or substitute each other, influenced by the investments' specific circumstances and the analysis's granularity. Thus, the motives of MNEs can affect whether investment and trade are complementary or competitive. Existing studies incorporate variables such as gross domestic product, natural resources, trade openness, inflation, population, geographical distance, and institutional factors to account for the determinants of export levels.

### 4.2.3 Hypotheses Development

The link between Chinese infrastructure investments and exports can be analyzed by detailing the investment behaviours of Chinese SOEs as multinationals in Africa, specifically through the characteristics of their projects. Typically, the theories emphasise FDI-exports

links but given the context surrounding Chinese infrastructure investment in Africa, this can be termed as a form of FDI. This is a business arrangement between Chinese SOEs and their African counterparts (government, ministries, firms), where as a result of the infrastructure investment, the SOEs hold mining rights, hold equity interest in a particular project, or acquire firms in Africa that are resource-oriented or are allocated oil blocs (Witness, 2011, Zhang et al., 2013; Konijn & vanTulder, 2015). Invariably, these allow them to gain access to primary resources in Africa. To what extent these rights are used to serve the local market, or their home country remains empirically unclear. For instance, the Industrial and Commercial Bank of China (ICBC) acquired a 20% share of the Standard Bank of South Africa. China National Petroleum Corporation (CNPC) purchased a 40% stake in Nile Petroleum Operating Company. More so, Sinopec holds a 50% interest in Angola BP. Moreover, CNPC possesses an oil block in Nigeria, and the Souapiti Dam in Guinea is associated with bauxite mining operations. We account for the influence of Chinese infrastructure on exports in Africa based on existing arguments about the infrastructure-gap in Africa and the resource-gap in China.

Moreover, the resource for infrastructure deal further accentuates the link between Chinese infrastructure investment and exports in Africa. This is a deal where natural resources such as crude oil, cocoa, diamond, and copper among others are being used to secure the infrastructure investment in Africa. For instance, projects such as the Bui Dam in Ghana and the Congo River Dam in the Congo receive funding from Chinese EXIM banks, driven by the involvement of Sinohydro Corporation (a Chinese state-owned enterprise). These projects are financially backed by resources like cocoa and crude oil (Urban et al., 2015; Konijn & van Tulder, 2015). The Chinese SOEs' activities surrounding the

infrastructure projects in Africa cannot be overlooked for viable policy design.

Therefore, the precursory discussions of the general theories on the foreign investment-exports link can be related to the significant role of Chinese SOEs in African infrastructure projects. Invariably, resources-seeking motive complements Africa's exports if Chinese SOEs are motivated by the raw materials needed for production in their home country. Moreover, in line with the R4I deals, Africa's exports are closely associated with infrastructure investment. Thus, a positive relationship is expected. However, if the motive is market-seeking, foreign investment may likely substitute exports. This is a situation whereby Chinese multinationals establish abroad to serve the recipient countries' market rather than exporting. Since their presence in non-primary industries (such as construction, transport, finance, etc.) is pronounced, a negative effect is expected. Therefore, Chinese infrastructure investment may displace Africa's exports. Pigato and Tang (2015) suggest that factors such as natural resources gain importance when the investment aims to procure raw materials for the home country. The authors note that infrastructure investment can enhance exports if the Chinese SOEs aim to export these resources back home to meet domestic industry needs. Conversely, GDP per capita becomes a relevant factor if the objective is to penetrate new markets. Examining the industry provides clear insights into the primary motives of Chinese SOEs in Africa. Popovic (2018) finds that analyzing countries and sectors individually reveals varied results. For instance, in the manufacturing sector, foreign direct investment (FDI) tends to substantially impact exports more than the service sector, which is predominantly influenced by domestic investment. Popovic also observes that foreign investment plays a more significant role in boosting exports in European Union (EU) countries. Based on the foregoing, the following hypotheses are

developed:

*Hypothesis one: The resource-seeking motive reinforces the positive effect of Chinese infrastructure investment on exports of countries and industries in Africa.*

*Hypothesis two: The market-oriented motive weakens the positive impact between Chinese infrastructure investment and exports of countries and industries in Africa.*

## 4.3 Empirical Strategy

### 4.3.1 Data and Sample

We obtained the data from a diverse range of data sources to construct a robust dataset. Our primary variable of interest, China's Overseas Infrastructure Investment (OII), was sourced from the China Global Investment Tracker (CGIT) and enriched with insights from the China-Africa Research Initiative. To assess the economic effects of these investments, we focused on exports to China as our main outcome variable, incorporating additional control variables from sources such as the United Nations Comtrade database, the International Monetary Fund's Direction of Trade statistics, the World Development Indicators (WDI), and the World Trade Organization (WTO) data. Our dataset stands out for its depth, offering a disaggregated view across both country and industry lines, thus providing a comprehensive lens through which to assess the patterns and impacts of Chinese investments.

This research encompasses all fifty-four African nations from 2005 to 2019, a crucial timeframe for capturing a broad spectrum of Chinese infrastructure activities on the continent. Notably, out of these nations, forty-six have received Chinese infrastructure investments, presenting an opportunity for a comparative analysis to discern the varied economic outcomes stemming from these investments.

Furthermore, our analysis dives into sector-specific dynamics, with data on fourteen industries that have been beneficiaries of Chinese infrastructure funding during our study

period. The UN Comtrade and WTO database contain the information on industries for African countries. By following the HS 2002 nomenclature using 2-digit codes (for merchandise exports) and EBOPS 2010 (service exports), we obtained data for 14 industries that received Chinese infrastructure investment for the period of 2005-2019. This is matched with the sectoral classification for each investment project in the CGIT database.

Our methodology for selecting countries and industries for inclusion was guided by the availability and reliability of data. Nevertheless, it is crucial to recognize a fundamental selection bias in our dataset, mainly because not all African countries have received Chinese infrastructure investments. This discrepancy introduces the need for a nuanced analytical approach to ensure our findings are representative and robust. To counteract potential biases and address endogeneity, we implemented the Heckman two-stage correction model, a sophisticated econometric technique that allows for a more accurate estimation of the effects of Chinese OII on African economies by including both recipient and non-recipient countries in our analysis (Certo, et al., 2016).

This comprehensive and methodologically sound approach enabled us to match outcome and control variable data with China's OII data across all fifty-four African countries. In doing this, the goal is to offer a detailed analysis of how Chinese infrastructure investments are transforming economic environments throughout Africa while carefully considering the implications of our results and any potential biases in our data.

### 4.3.2 Model Specification

In exploring the effect of China’s OII on Africa's export performance to China, we utilize the Heckman two-stage model, an econometric approach that integrates concepts from

theories of multinational enterprises (MNEs) and new trade. This method is particularly effective for addressing endogeneity and mitigating sample selection bias, offering a significant advantage over traditional ordinary least squares (OLS) methods. The inclusion of exclusion restriction (ER) variables, as advocated by Heckman & Vytlacil (2001), serves to reduce multicollinearity among predictors and the correlation between error terms, enhancing the model's accuracy and reliability.

The selection of 'legal origin' as an ER variable in our study necessitates a detailed justification, especially considering its potential implications for export dynamics. Legal origin captures the historical basis of a nation's legal framework and its effect on business regulations, influences the investment environment and thus affects a country's attractiveness to foreign investors, such as those from China. This impact is articulated through its effect on transaction costs, the enforcement of contracts, and the protection of investor rights, factors that are indirectly associated with a nation's capacity to engage in international trade (La Porta et al., 1998).

The legal origin was selected as an ER because of its indirect relationship with export performance. Although legal origin may influence the overall business environment and, by extension, economic activities such as exports, its direct impact on the specific relationship between Chinese infrastructure investments and exports to China is minimal. This subtlety aligns with the requirements for an ER variable, which should affect the selection process without directly impacting the outcome variable. In our model, we posit that legal origin primarily influences the likelihood of a country receiving Chinese infrastructure investments rather than directly affecting export performance, thereby meeting the criteria

for an ER variable to correct for endogeneity and selection bias (Heckman, 1979). Moreover, while the potential influence of legal origin on export activities warrants consideration, it is important to note that countries with legal systems effectively protecting property rights and minimizing transaction costs might exhibit enhanced international trade competitiveness. Nonetheless, the direct relationship between legal origin and export performance is nuanced and warrants careful examination. This premise rests on the belief that the critical determinants of export performance, particularly in scenarios involving Chinese infrastructure investments, are more tied to improvements in infrastructure and economic conditions than to the broader legal framework (North, 1990).

Empirical studies, such as Djankov et al. (2010), further support the role of legal origin in financial development and investment decisions, indirectly affecting a country's export capabilities through improved infrastructure and investment climate. Thus, our application of legal origin as an ER variable is consistent with existing literature, addressing the complex interplay between legal frameworks, foreign investment, and economic outcomes in Africa's trade relations with China.

Following trade literature, we derive our probit model that allows $Probability\ (Recipient_{ijt} = 1)$ to depend on theoretical informed macro-economic variables (i) GDP per capita *(GDP)* (ii) Natural resource *(NR)*(iii) Institutional quality (*INQ*) (iv) Existing infrastructure (*INF*) (v) Trade openness (*TO*) (vi) African domestic investment (*ADV*) (vii) Population (*POPU*) (viii) Legal origin (*LO*) (which is used as exclusion restriction variable). The model covers 54 countries *i*, 14 industries *j* over 15years *t*. The equation of the probit model is as follows:

**First stage**

$$Probability\ (Recipient_{it} = 1) = \beta_0 + \beta_1 GDP_{it-1} + \beta_2 NR_{it-1} + \beta_3 INQ_{it-1} + \beta_4 TO_{it-1} + \beta_5 LO_{it-1} + \beta_6 INF_{it-1} + \beta_7 ADV_{it-1} + \mu_i + \varepsilon it \quad (1)$$

Where the outcome variable is a binary variable ($Recipient_{it}$), which is denoted as 1 if a country in Africa received infrastructure investment from China and otherwise 0. Also, the exclusion research instrument is of legal origin. According to La Porta (1999), inline with the law and finance literature, legal origin enhances financial sector development, which can influence the decisions of foreign investors. As such, this variable does not havea direct influence on exports. The term $\mu i$ represents the individual-specific error component, while $\varepsilon it$ denotes the fundamental error component.

**Second stage**

Considering the role of Chinese infrastructure investment on the Africans' export performance, exports to China are the dependent variable, and Chinese infrastructure investment is the primary explanatory variable. Next, we account for the standard determinants of exports pertinent to this study and incorporate the Inverse Mills Ratio (IMR) derived from the initial stage (model 1). Thus, we obtain the following empirical model:

$$EXP_{it} = \beta_0 + \beta_1 Investment_{it-1} + \beta_2 GDP_{it-1} + \beta_3 NR_{it-1} + \beta_4 INQ_{it-1} + \beta_5 INFLA_{it-1} + \beta_6 DIST_{it-1} + \beta_7 POP_{it-1} + \beta_8 TO_{it-1} + \beta_9 ADV_{it-1} + \beta_{10} IMR_{it-1} + \mu_i + \varepsilon_{it} \quad (2)$$

Where $Investment_{it-1}$ represents the volume of Chinese infrastructure investment, *EXP* is the African countries' exports to China (in $'millions). *GDP* is the per capita GDP of country i, *INQ* is the institutional quality of country i. *INFLA* is the rate of inflation of African countries. *DIST* measures the distance from the capital of an African host country to the capital of China (in kilometres). *POPU* represents the labour force. *TO* is the trade openness

of country$_i$ to World. $ADV$ is the Africans' domestic investment. T represents time period. $\varepsilon_{it}$ is the error term in the model.

### 4.3.3 Description of Variables

The inclusion of variables such as exports to China, Chinese infrastructure investment, GDP per capita, distance, domestic investment and institutional quality in the empirical model draws on established literature that examines the dynamics of international trade and investment. For instance, the role of China's OII in facilitating trade is supported by research that highlights the importance of infrastructure in lessening transaction costs and enhancing market accessibility (Donaubauer et al., 2016). This aligns with the new trade theory, which suggests that infrastructure investments can lead to increased export performance by improving the efficiency of transportation and logistics (Krugman, 1980). Furthermore, the selection of GDP per capita as a variable resonates with the market-seeking motive outlined in international business literature, where firms seek to enter larger and more affluent markets to exploit economies of scale (Dunning, 1980). Institutional quality, as aggregated from governance indicators, is integral to this model, echoing the findings of studies like those by Rodrik et al. (2004), which argue that the rule of law and good governance are critical for economic growth and, by extension, trade.

Other determinants like trade openness, natural resources, inflation rate, existing infrastructure, and distance are emphasized in classical and modern economic theories for their relevance to trade relationships. Specifically, trade openness is defined by the trade ratio to GDP, following the gravity model. This model suggests that economic openness and overall economic scale affect a nation's likelihood to engage in trade (Anderson,1979). The

inclusion of natural resources rent to GDP underscores the resource-seeking behavior of countries, aligning with the Heckscher-Ohlin model that suggests countries export goods for which they have an abundance of factors of production (Heckscher, 1919; Ohlin, 1933). The inflation rate is a traditional economic variable indicative of economic stability, which affects trade conditions (Fischer, 1993). The model's consideration of existing infrastructure, specifically broadband subscriptions, aligns with literature that emphasizes communication technology in facilitating trade by aiding the flow of information (Freund & Weinhold, 2004). Lastly, the geographical distance between trading partners is a fundamental aspect of the gravity principle, affecting transaction costs and trade flows (Bergstrand, 1985), while legal origin, reflecting on the work of La-Porta et al. (1999), signifies the influence of legal systems on economic transactions and, by extension, on investment patterns and international trade. The detailed explanations of the variables are in the appendix.

### 4.3.4 Summary Statistics

Table 4.1 shows the descriptive statistics of the variables used in the analysis. Firstly, the difference between Africa's exports to China and China's reported imports from Africa, with means of $1317.489 million and $1052.906 million respectively, signals a noteworthy trade imbalance. This gap suggests either underreporting by China or overreporting by African countries, or a mix of valuation, timing, and recording discrepancies between these trade partners. Further, the average Chinese infrastructure investment in Africa stands at $520.901 million, which, although substantial, is smaller than half the value of exports to China. This juxtaposition underscores the multi-faceted nature of Sino-African economic relations, where trade and investment are crucial but distinct components.

The mean debt to China among the surveyed African countries being $175.223 million highlights the significant financial influence China has on the continent, possibly reflecting the strategic deployment of China's OII and initiatives such as the One Belt and Road Initiative. In addition, the low prevalence of commodity-based payment loans, with an average of about 0.049 countries engaged, indicates that such financial arrangements are not the primary method of debt service in Sino-African economic relations.

Moreover, the negative mean value for institutional quality (-0.685) raises concerns about governance issues across the continent, potentially impacting economic performance and the efficacy of foreign investments. Conversely, the trade openness metric, with an average of 0.701, suggests a significant level of engagement by African countries with the global economy, excluding China. This indicates a broad economic strategy beyond the focus on China, aiming for diversified global integration.

Regarding the development variables, the GDP per capita, inflation rate, existing infrastructure, and natural resources paint a complex picture of varying economic conditions and challenges within African countries. The substantial variation in natural resources and domestic investment figures, alongside the diversity in population sizes and distances from China, further emphasizes the heterogeneity across the continent. This heterogeneity suggests that the economic outcomes and impacts of Chinese engagement may vary widely across different African contexts.

**Table 4.1 Descriptive Statistics**

| Variable | Observations | Mean | Standard. Deviation. | Min | Max |
|---|---|---|---|---|---|
| Africa exports to China ($'million) | 810 | 1317.489 | 4648.147 | 0.000 | 48313 |
| China's reported imports from Africa ($'million) | 810 | 1052.906 | 2144.4 | 0.000 | 40556.5 |
| Infrastructure Investment ($'million) | 810 | 520.901 | 1242.432 | 0.000 | 12200 |
| Recipient | 810 | 0.379 | 0.485 | 0.000 | 1.000 |
| Debt to China ($'million) | 810 | 175.223 | 819.466 | 0.000 | 19343 |
| Resource for Infrastructure | 810 | 0.049 | 0.217 | 0.000 | 1.000 |
| GDP per capita | 810 | 7.258 | 1.045 | 5.022 | 10.041 |
| Inflation rate | 810 | 0.074 | 0.111 | -0.253 | 1.007 |
| Trade openness | 810 | 0.701 | 0.439 | 0.000 | 3.480 |
| Institutional quality | 810 | -0.685 | 0.636 | -2.449 | 0.854 |
| Existing infrastructure | 810 | 0.964 | 2.708 | 0.000 | 27.598 |
| Natural resource | 810 | 12.270 | 13.193 | 0.000 | 68.790 |
| African domestic investment | 810 | 21.609 | 12.290 | -0.098 | 77.890 |
| Population | 810 | 15.329 | 1.557 | 10.94 | 18.494 |
| Distance (Kilometers) | 810 | 10362 | 1478 | 6744 | 12567 |
| Legal origin | 810 | 0.370 | 0.483 | 0.000 | 1.000 |

Note: GDP per capita and population are in log form. See Appendix 1 for definition and measurement of variables.

A descriptive analysis of the sector-wise distribution of Chinese infrastructure investment and exports to China from Africa, as presented in Table 2, reveals insightful patterns into the strategic priorities of Chinese investments and the corresponding trade dynamics. The energy sector, with the highest average infrastructure investment ($221.551 million) and exports to China ($541.876 million), clearly underscores China's resource-seeking agenda, particularly for energy resources. This is further evidenced by the pronounced investment and export figures in primary industries like agriculture, metals, and chemicals, highlighting a targeted approach towards securing access to crucial raw materials. Interestingly, while the transportation sector receives substantial investment ($176.763 million), its export figures are relatively low ($2.438 million), suggesting the investment's role in enhancing logistic capabilities rather than direct trade gains. Conversely, the industrial sector shows a remarkable capacity to export ($764.961 million) against relatively modest investments ($5.333 million), reflecting a significant

contribution to Africa's export performance to China. This sectoral analysis not only reinforces the resource-seeking nature of Chinese investments but also illuminates the varied impact of these investments on trade dynamics, laying a foundation for understanding the complex interplay between investment flows and trade pattern.

**Table 4.2 Mean statistics by Sector**

| Sectors | Mean ($'million) Infrastructure Investment | Mean ($'million) Export to China |
|---|---|---|
| Agriculture | 10.913 | 26.306 |
| Metals | 66.449 | 53.568 |
| Energy | 221.551 | 541.876 |
| Chemicals | 8.261 | 4.938 |
| Machinery & Electricity | 11.913 | 2.377 |
| Textile | 2.13 | 9.787 |
| Industrial | 5.333 | 764.961 |
| Transportation | 176.763 | 2.438 |
| Financial | 9.464 | 0.44 |
| Construction | 66.261 | 3.161 |
| Travel | 2.913 | 61.35 |
| Entertainment | 2.594 | 0.158 |
| Logistics | 4.217 | 0.016 |
| Telecommunication service | 11.725 | 3.928 |

Notes: primary industry comprises of agriculture, metals, energy and chemicals. Manufacturing industry includes machinery and electricity, textile, industrial and transportation. While service industry includes financial, construction, travel, entertainment, logistics and telecommunication service.

Tables 4.3 present the matrix of correlation and variance inflation factor (VIF) (shown in the appendix). Overall, correlations between variables show an absence of serious multicollinearity among variables. We also checked the VIF test for the variables, which shows that the values of the variables are below the benchmarkof 10. Thus, the correlation matrix and VIF support that multicollinearity is not a severe problem in this paper.

**Table 4.3 Correlation matrix**

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.00 | | | | | | | | | | | | | |
| 2 | 0.14* | 1.00 | | | | | | | | | | | | |
| 3 | 0.24 | 0.20 | 1.00 | | | | | | | | | | | |
| 4 | 0.25 | 0.27* | 0.34* | 1.00 | | | | | | | | | | |
| 5 | 0.28 | 0.06 | 0.07 | 0.05 | 1.00 | | | | | | | | | |
| 6 | 0.06 | 0.09* | 0.17* | 0.09* | -0.13 | 1.00 | | | | | | | | |
| 7 | 0.02 | -0.11 | -0.01 | -0.04 | 0.30 | -0.10 | 1.00 | | | | | | | |
| 8 | 0.00 | -0.15 | -0.16* | -0.08* | 0.29 | -0.11 | 0.09* | 1.00 | | | | | | |
| 9 | 0.01 | -0.01 | -0.08* | -0.04 | 0.42 | -0.12 | 0.14 | 0.37* | 1.00 | | | | | |
| 10 | 0.16* | 0.15* | 0.17* | 0.07 | 0.14 | 0.19 | 0.24 | -0.47 | -0.21 | 1.00 | | | | |
| 11 | 0.03 | 0.08 | 0.02 | 0.06 | 0.22 | -0.08 | 0.35 | 0.23 | 0.23 | 0.13* | 1.00 | | | |
| 12 | 0.21* | 0.36 | 0.17* | 0.15* | -0.26 | 0.16 | -0.31 | -0.25 | -0.09 | 0.02 | 0.09* | 1.00 | | |
| 13 | 0.06 | -0.08 | 0.04 | -0.04 | -0.04 | -0.07 | 0.21 | 0.26 | -0.22 | 0.05 | 0.17* | -0.24* | 1.00 | |
| 14 | 0.05 | 0.04 | 0.02 | -0.02 | -0.09 | 0.15 | 0.02 | 0.19* | -0.16* | -0.16* | -0.09* | 0.12* | 0.23* | 1.00 |

Note: GDP per capita, population, distance are in log form. See Appendix 1 for definition and measurement of variables. * shows significance at 0.05 level.

*1- Exports*
*2.-Infrastructure investment*
*3- Resource for infrastructure*
*4- Debt to China*
*5-Gross domestic product*
*6- Inflation rate*
*7- Trade openness*
*8-Institutional quality*
*9- Existing infrastructure*
*10- Natural resources*
*11-African domestic investment*
*12- Population*
*13- Distance*
*14- Legal origin*

## 4.4 Empirical Result

### 4.4.1 The First Stage Estimation: Explaining whether an African Country is a Recipient of China's Infrastructure Investment

Table 4.4 illustrates the findings from the first stage of the Heckman selection model, which assesses the likelihood of an African nation receiving Chinese infrastructure investment (Recipient). The results show a positive correlation between GDP per capita and the likelihood of receiving this investment, as evidenced by a coefficient of 0.2333, which is significant at the 1% level. This finding supports the idea of resource-seeking and market-seeking motives, consistent with the findings of Zhang et al. (2013) and Amighini et al. (2013). The coefficient for natural resources is 0.0176, which is also significant at the 1% level. The significance of institutional quality, with a coefficient of 0.2535 and significant at the 10% level, underscores the role of governance in attracting foreign investments, reflecting the insights provided by Rodrik, Subramanian, and Trebbi (2004).

The population variable is positively significant at the 1% level (with a coefficient of 0.5852), suggesting a preference for countries with larger labour forces. This supports theories on the importance of demographic factors in investment decisions (Becker, 1962). Notably, the legal origin variable's significance at the 1% level with a coefficient of 0.3745 highlights the influence of legal frameworks on investment flows, underpinning the exclusion restriction's validity in the model. This is in line with the law and finance literature that suggests legal origins significantly affect economic outcomes (La Porta et al., 1999). Overall, the model performance is acceptable as shown by the Wald Chi-square test. The Wald test of the Probit model is highly significant, showing that explanatory variables' coefficients contribute significantly to the model (Heckman, 1979). Likewise, the reported McFadden pseudo-R-squared is 0.2820, which indicates areasonably good model fit.[6]

[6] McFadden (1977) asserts that the rule of thumb for a good McFadden's pseudo-R-squared is usually set between 0.2-0.4.

**Table 4.4 The first stage estimation: Explaining whether an African country is a recipient of China infrastructure investment**

| Variables | Dependent variable<br>Prob (Recipient=1) |
|---|---|
| *Gross domestic product* | 0.2333*** |
| | (0.0711) |
| *Natural resource* | 0.0176*** |
| | (0.0059) |
| *Trade openness* | -0.0008 |
| | (0.0028) |
| *Institutional quality* | 0.2535* |
| | (0.1410) |
| *Existing infrastructure* | -0.0247 |
| | (0.0391) |
| *Domestic investment* | 0.0033 |
| | (0.0059) |
| *Population* | 0.5852*** |
| | (0.0589) |
| *Legal origin* | 0.3745*** |
| | (0.1294) |
| Constant | -11.4841*** |
| | (1.2113) |
| Pseudo $R^2$ | 0.2820 |
| Wald $X^2$ | 190.39*** |
| Observations | 756 |

Note: This table presents the results of a Probit estimation where the dependent variable indicates whether an African nation has received infrastructure investment from China. All explanatory and control variables are taken from the preceding year. The model includes year and regional dummy variables. Robust standard errors are shown in parentheses. The Wald test Chi-squared and pseudo-R-squared values are used to evaluate the model's overall effectiveness. For definitions and measurements of variables, refer to the appendix. Significance levels are marked as ***, **, and * for 1%, 5%, and 10%, respectively.

### 4.4.2 Impact of Infrastructure Investment on Export Performance of African Countries

Table 4.5 presents the second-stage outcomes of the Heckman model, incorporating the inverse Mills ratio (Lambda). In this model, the dependent variable is the logarithmic value of African exports to China. The focal variable, infrastructure investment, shows a positive correlation with African exports to China, exhibiting a coefficient of 0.5004, which is statistically significant at the 1% level. This highlights the crucial impact of Chinese OII on boosting African export performance. This finding corroborates the resource-seeking motives of Chinese investments and is aligned with the theoretical perspectives of new trade and Multinational Enterprise (MNE) theories, as well as empirical findings by Onyekwenu et al. (2017).

Regarding the control variables, GDP per capita of recipient African countries positively influences exports to China, (with a coefficient of 0.2557) at the 1% significant level. This emphasises the importance of market size in export promotion, resonating with existing literature that highlights the positive correlation between the economic size of a country and its export capacity. A sizable coefficient of 5.0491 at the 1% level shows how significantly natural resources affect export performance, highlighting the significance of resource endowment, a recurring theme in trade economics literature. In contrast, trade openness is negatively related to exports to China, as evidenced by a coefficient of -0.2195, which is significant at the 5% level. This indicates that broader trade liberalisation might negatively affect exports specifically targeted at China, adding a layer of complexity to the understanding of trade openness effects. The population variable (the size of the active labour force) is positively associated with export performance. It is statistically significant at the 1% level with a coefficient of 0.7381, underscoring the labour force's role in boosting

exports. The distance between China and African nations has a negative relationship with exports, with a coefficient of -0.5809, which is significant at the 10% level, supporting the gravity model of trade that suggests longer distances decrease trade volumes. Moreover, the positive influence of African domestic investment on exports to China, with a coefficient of 0.7006, significant at the 10% level, indicates that internal market development within African countries favourably impacts export activities to China.

When comparing these results with China's reported imports from Africa, distinct differences emerge. Notably, the coefficient for infrastructure investment in this context is much lower (0.0981) and significant at the 10% level. This suggests a weaker direct relationship between Chinese infrastructure investment and its reported imports from Africa. This disparity could reflect differences in reporting standards or the valuation of traded goods. The control variables are in tandem with the export-to-China model, except for institutional quality, which is surprisingly positively significant at 1% with China's reported imports (with a coefficient of 0.4992). This suggests that governance and institutional frameworks significantly impact how trade flows are facilitated.

As seen from Table 4.4, inverse mills ratio (lambda) coefficients are significant, indicating that the correction of the Heckman model is needed and justified. This also reflects control of endogeneity for the variables.

**Table 4.5 Impact of infrastructure investment on export performance**

| | Africa export to China | China reported import from Africa |
|---|---|---|
| *Infrastructure investment* | 0.5004*** | 0.0981* |
| | (0.1800) | (0.0507) |
| *Gross domestic product* | 0.2557*** | 0.1564* |
| | (0.0951) | (0.0931) |
| *Natural resource* | 5.0491*** | 0.0644*** |
| | (0.7705) | (0.0101) |
| *Trade openness* | -0.2195** | 0.0003 |
| | (0.0976) | (0.0011) |
| *Institutional quality* | -0.1044 | 0.4992*** |
| | (0.1183) | (0.1663) |
| *Inflation rate* | 1.0487 | -0.0004 |
| | (0.6461) | (0.0010) |
| *Population* | 0.7381*** | 1.3754*** |
| | (0.1362) | (0.2317) |
| *African domestic investment* | 0.7006* | 0.0027 |
| | (0.4141) | (0.0043) |
| *Distance* | -0.5809* | -3.2250*** |
| | (0.3427) | (0.8239) |
| *Inverse Mills Ratio* | 1.1110*** | 2.7060*** |
| | (0.2790) | (0.5133) |
| Constant | -9.1761* | -4.5402*** |
| | (5.1001) | (1.4326) |
| Observations | 644 | 644 |
| R-squared | 0.359 | 0.369 |

Note: This table displays the results of the second-stage Heckman regression, where the dependent variables include Africa's exports to China and China's reported imports from Africa. All explanatory and control variables are lagged by one year. The Inverse Mills Ratio, derived from the Probit regression, is incorporated. The model also includes year, industry, and country dummy variables. Parentheses contain robust standard errors. Refer to the Appendix for the definition and measurement of variables. Asterisks (***, **, and *) indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

### 4.4.3 Impact of Resource for Infrastructure on Export Performance of African Countries

Table 4.6 examines the Resources for Infrastructure (RFI) agreements between African nations and China, offering valuable perspectives on their impact on export dynamics. These RFI deals, which typically involve Chinese infrastructure loans in return for access to African natural resources, are positively related to both exports from Africa to China and imports by China from African countries. Specifically, the coefficient of the RFI dummy variable is positively correlated with Africa's exports to China, with significance at the 5% level, and with China's imports from Africa, with significance at the 1% level. This dual positive effect underscores the mutual benefits inherent in RFI deals, reinforcing the symbiotic nature of such agreements that bolster exports to China while ensuring resource access for China, consistent with the resource-seeking motives of Chinese investments (Bräutigam and Gallagher, 2014).

The positive and significant coefficients for the RFI term, indicating enhanced trade on both export and import front, this conforms with the hypothesis that RFI deals play a role in facilitating trade between Africa and China. This aligns with existing literature suggesting that such commodity-based payment loans are instrumental in deepening economic ties and promoting reciprocal trade benefits (Alden, 2007; Carmody, 2011).

For control variables like natural resources and trade openness, their effects on trade dynamics are consistent with findings from other segments of the analysis, affirming the resource endowment's critical role and the nuanced impact of trade policies on exports to China. Furthermore, the positive significance of the lambda in the model justifies the employment of the Heckman selection model, addressing

potential selection bias and endogeneity issues, thereby enhancing the reliability of the estimated impacts (Heckman, 1979).

This examination of the RFI's impact, elucidates the complex interplay of factors shaping export's trade relationship with China. It not only confirms the strategic resource-seeking agenda of Chinese investments but also highlights the instrumental role of RFI deals in promoting export performance among African countries, offering a nuanced understanding of how such financial mechanisms underpin Sino-African economic interactions.

**Table 4.6 Impact of Resource for infrastructure as mediating variable on exports performance**

| | Africa export to China | China reported import from Africa |
|---|---|---|
| *Resource for infrastructure* | 0.3787** | 1.0396*** |
| | (0.17525) | (0.3141) |
| *Gross domestic product* | 0.3477 | 0.0447 |
| | (0.3411) | (0.0941) |
| *Natural resource* | 5.1656* | 0.0641*** |
| | (8.1310) | (0.0099) |
| *Trade openness* | 0.0196 | 0.0004 |
| | (0.1085) | (0.0011) |
| *Institutional quality* | 4.5204*** | 0.6132*** |
| | (0.7514) | (0.1696) |
| *Real exchange rate* | -0.2260** | -0.0003 |
| | (0.1045) | (0.0010) |
| *Population* | 0.0433 | 1.3282*** |
| | (0.1118) | (0.2338) |
| *African domestic investment* | 0.9659 | 0.0033 |
| | (0.6640) | (0.0043) |
| *Distance* | 0.5465*** | 2.7039*** |
| | (0.1235) | (0.8061) |
| *Inverse Mills Ratio* | 0.7370* | 2.6138*** |
| | (0.4343) | (0.5145) |
| Constant | -0.6836 | -0.0192*** |
| | (0.6206) | (1.2419) |
| Observations | 644 | 644 |
| R-squared | 0.364 | 0.388 |

Note: This table displays the results of the second-stage Heckman regression, where the dependent variables include Africa's exports to China and China's reported imports from Africa. All explanatory and control variables are lagged by one year. The Inverse Mills Ratio, derived from the Probit regression, is incorporated. The model also includes year, industry, and country dummy variables. Parentheses contain robust standard errors. Refer to the Appendix for the definition and measurement of variables. Asterisks (***, **, and *) indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

### 4.4.4 Impact of Resource-seeking versus Market-seeking Approach as Mediating Variables

Here, we introduce two interaction terms to capture the theoretical effect of resource-seeking and market-seeking motives. These are included in columns 1 and 2 in Table 4.6a and 6b, respectively, to accentuate the motives of the Chinese SOEs in the foreign investment-exports (Africa exports to China and China reported import from Africa).

In Table 4.7, the interaction term for resource-oriented investment (infrastructure investment * natural resource) is positively significant with Africa's exports to China, at the 1% level with a coefficient of 1.1404. This conforms with the resource-seeking motive, suggesting that Chinese infrastructure investments are strategically aimed at securing access to African natural resources, in line with Xin and Gyan (2020) and Onyekwenu et al. (2017). The relationship between the interaction term (infrastructure investment * GDP), representing the market-seeking motive, is negatively significant at 5% with a coefficient of -0.0119. This suggests a subtle relationship where investments aimed at market access may reduce the direct effect on exports to China, highlighting a more intricate connection between investment motives and export results.

Comparatively, in Table 4.8, which concentrates on China's imports from Africa, the resource-seeking interaction term consistently reveals a significant positive relationship (coefficient= 0.0240) at the 1% level, highlighting the role of natural resources in trade interactions. Conversely, the market-seeking interaction term exhibits a negative significance (coefficient= -0.0174) at the 10% level. This reflects the complex interplay between gaining market access in Africa and promoting resource exports.

These results highlight the essential roles that resource and market orientations play

in determining the patterns of infrastructure investment and trade between China and African countries. The positive and significant coefficients for resource-seeking motives affirm the prevalent theory that Chinese investments are primarily driven by the need to secure vital resources. Conversely, the negative coefficients associated with market-seeking motives suggest a more intricate relationship, potentially indicating that while Chinese SOEs invest in infrastructure to access African markets, such investments might not directly enhance exports to China as anticipated. This dual strategy reflects the sophisticated global engagement approach of Chinese SOEs, navigating between securing resources and exploring market opportunities within Africa. The significant Inverse Mills Ratio (IMR) across analyses justifies the Heckman model's application, addressing selection bias and ensuring the robustness of the findings.

**Table 4.7 Impact of Chinese SOEs motivation on Africa exports to China**

| | (1) Resource-seeking | (2) Market-seeking |
|---|---|---|
| *Infrastructure investment* | -0.2903 | 0.5886*** |
| | (0.5773) | (0.1873) |
| *Infrastructure investment * Natural resource* | 1.1404*** | |
| | (0.3520) | |
| *Infrastructure investment * Gross domestic product* | | -0.0119** |
| | | (0.0050) |
| *Gross domestic product* | 0.3008*** | 0.5506*** |
| | (0.0934) | (0.1374) |
| *Natural resource* | 4.1825*** | 4.6269*** |
| | (0.7402) | (1.3307) |
| *Trade openness* | -0.2249** | -0.5967*** |
| | (0.0933) | (0.1535) |
| *Institutional quality* | -0.1376 | -0.2699 |
| | (0.1175) | (0.1882) |
| *Inflation rate* | 0.9912 | 0.4801 |
| | (0.5800) | (0.6922) |
| *Population* | 0.6583*** | 0.9238*** |
| | (0.1378) | (0.2261) |
| *African domestic investment* | 0.6878* | 2.1962*** |
| | (0.4020) | (0.5649) |
| *Distance* | -0.1491 | -0.2035 |
| | (0.3112) | (0.2937) |
| *Inverse Mills Ratio* | 1.0530*** | 1.6732*** |
| | (0.2780) | (0.4891) |
| Constant | -12.1657** | -18.9450*** |
| | (4.8953) | (5.7712) |
| Observations | 644 | 644 |
| R-squared | 0.404 | 0.261 |

Note: This table displays the results of the Heckman second stage regression where the dependent variable is Africa's exports to China. All explanatory and control variables are delayed by one year. Interaction terms (Infrastructure investment * Natural resource and Infrastructure investment * Gross domestic product) are included in the model to highlight the roles of mediating variables. The Inverse Mills Ratio, calculated from the Probit regression, is also incorporated. Year, industry, and country-specific dummies are added to the analysis. Robust standard errors are indicated in parentheses. For definitions and measurements of the variables, refer to the Appendix. Levels of statistical significance are marked as ***, **, and *, corresponding to 1%, 5%, and 10% levels, respectively.

**Table 4.8 Impact of Chinese SOEs motivation in China import from Africa**

| | (1) Resource-seeking | (2) Market-seeking |
|---|---|---|
| *Infrastructure investment* | 0.1103* | 0.6511** |
| | (0.1373) | (0.0073) |
| *Infrastructure investment * Natural resource* | 0.0240*** | |
| | (0.0067) | |
| *Infrastructure investment * Gross domestic product* | | -0.0174* |
| | | (0.0890) |
| *Gross domestic product* | 0.21128*** | 0.2421** |
| | (0.0563) | (0.0944) |
| *Natural resource* | 2.9341*** | 0.0479*** |
| | (0.4102) | (0.0096) |
| *Trade openness* | -0.3290** | -0.0010 |
| | (0.0933) | (0.0010) |
| *Institutional quality* | -0.2468 | 0.2793* |
| | (0.4110) | (0.1529) |
| *Inflation rate* | 0.2323 | -0.0015 |
| | (0.3342) | (0.0010) |
| *Population* | 0.3468*** | 1.2097*** |
| | (0.0876) | (0.2250) |
| *African domestic investment* | 0.4352* | 0.0035 |
| | (0.5611) | (0.0042) |
| *Distance* | -0.3770 | 3.3063*** |
| | (0.2122) | (0.8079) |
| *Inverse Mills Ratio* | 2.7060*** | 2.2531*** |
| | (0.5133) | (0.4879) |
| Constant | -4.5402*** | -2.5855*** |
| | (1.4326) | (1.3439) |
| Observations | 644 | 644 |
| R-squared | 0.369 | 0.431 |

Note: This table displays the results of the Heckman second stage regression where the dependent variable is China reported import from Africa All explanatory and control variables are delayed by one year. Interaction terms (Infrastructure investment * Natural resource and Infrastructure investment * Gross domestic product) are included in the model to highlight the roles of mediating variables. The Inverse Mills Ratio, calculated from the Probit regression, is also incorporated. Year, industry, and country-specific dummies are added to the analysis. Robust standard errors are indicated in parentheses. For definitions and measurements of the variables, refer to the Appendix. Levels of statistical significance are marked as ***, **, and *, corresponding to 1%, 5%, and 10% levels, respectively.

### 4.4.5 Impact of Nature of the project (Primary versus Non-primary Industry)

Next, to best capture the individual effect of industry's infrastructure investment on exports, we classify sectors that received Chinese infrastructure investment into the primary industry (agriculture, metals, energy, and chemicals) and non-primary industry (machinery and electricity, textile, consumer goods, transportation, financial,

construction, travel, entertainment, logistics, and telecommunication). The analysis is based on data on Africa's exports to China. We could not mirror China's import from Africa because of data unavailability.

The primary is measured as the project investment amount in the primary industry. Likewise, non- primary is captured as the project investment in the non-primary industry. These are introduced to capture the effect of the nature of the projects in each industry on exports.Table 4.9 shows the results of the second stage of the Heckman selection model, including lambda for the nature of the projects. (1) In column one, the *primary infrastructure investment* estimated coefficient is positively andsignificantly affecting exports to China. Invariably, hypothesis five is confirmed, implying that the primary industry's China's OII have a complementary relationship with exports to China. This aligns with the new trade theory and findings of Onyekwenu et al. (2017). This further accentuates the resource- seeking motive of Chinese infrastructure investment in Africa. (2) However, in column two, the *non-primary infrastructure investment* estimated coefficient has a negative and significant relationship with exports. Invariably, hypothesis six is supported, and this suggests that in the non-primary industry, Chinese infrastructure investment has a substitutability relationship with exports to China. This is in line withthe new trade theory.

Overall, the nature of the projects in each industry reinforces the relationship between Chinese infrastructure investments and exports positively and negatively. This clearly shows that Chinese SOE's investment activities in the primary industry are resource-seeking while market-seeking in the non-primary industry. Unsurprisingly, the construction sector is part of the non-primary industry, and the Chinese SOEs currently dominate this as a contractor for infrastructure projects.

For the control variables, we observe the following: (1) The estimated coefficient for GDP is significant and positive, indicating that larger market sizes in the countries of these sectors enhance their export capabilities. (2) The coefficient for natural resources is also significant and positive, suggesting that a greater abundance of natural resources increases exports to China. (3) The population variable shows a significant and positive impact at the 1% level across all four sectors, indicating that a larger labour force supports the export activities of these industries. (4) The coefficient for distance is negative and significant, reinforcing the idea that geographical proximity is crucial; industries closer to China tend to have higher export volumes.

**Table 4.9 Impact of nature of the projects on export performance**

| | (1)<br>Exports | (2)<br>Exports |
|---|---|---|
| *Infrastructure investment (primary)* | 0.1844** | |
| | (0.0920) | |
| *Infrastructure investment (non-primary)* | | -0.2390** |
| | | (0.1003) |
| *Gross domestic product* | 0.2839 | 0.2786* |
| | (0.2096) | (0.1523) |
| *Natural resource* | 6.6363*** | 6.9009*** |
| | (1.3857) | (1.1584) |
| *Trade openness* | 0.5970 | 0.2444 |
| | (0.3649) | (0.3373) |
| *Institutional quality* | 0.2545 | -0.2567 |
| | (0.2328) | (0.2258) |
| *Inflation rate* | 2.2398 | 2.4395 |
| | (1.5134) | (1.3312) |
| *Population* | 0.8524*** | 0.9531*** |
| | (0.2382) | (0.2096) |
| *African domestic investment* | -0.9955 | 0.0937 |
| | (0.8556) | (0.7511) |
| *Distance* | 0.6378 | -1.4160* |
| | (1.2179) | (0.7601) |
| *Inverse Mills Ratio* | 0.7571 | 0.7863 |
| | (0.5787) | (0.4885) |
| Constant | -2.3089 | -5.2048 |
| | (1.3970) | (9.0702) |
| Observations | 644 | 644 |
| R-squared | 0.353 | 0.497 |

Note: This table displays the results from the second-stage Heckman regression analysis, where the dependent variable is export performance. All explanatory and control variables are lagged by one year to ensure temporal consistency. The model incorporates interactive terms for infrastructure investment (distinguished between primary and non-primary sectors) to highlight industry-specific effects. The Inverse Mills Ratio, calculated from the Probit regression, is also included. Additionally, year, industry, and country-specific dummies are utilized. Parentheses contain robust standard errors. Definitions and measurements of variables can be found in the Appendix. Levels of statistical significance are indicated by ***, **, and *, corresponding to 1%, 5%, and 10%, respectively.

Next, the nuanced exploration of the impact of China's OII on export performance across different sectors, as detailed in Tables 4.10 and 4.11, delineates a clear distinction between the primary and non-primary sectors' reactions to China's investments in Africa. This distinction is pivotal in understanding the sector-specific dynamics and underlying motivations of Chinese investments, especially when dissected through the lens of resource-seeking and market-seeking approaches.

In the primary industry (Table 4.10), infrastructure investments significantly boost exports across several sectors, including agriculture, metals, and energy, showing notable positive coefficients. For example, in the metals sector, infrastructure investment has a marked influence on exports, with a coefficient of 0.5999, which is statistically significant at the 1% level. This strong correlation emphasizes the resource-seeking intent behind Chinese investments, aiming primarily to secure essential raw materials, in line with the vertical integration model proposed in the new trade theory (Helpman, 1984). However, the chemicals sector does not show a significant relationship, indicating sector-specific variations in how investment impacts export performance.

Comparatively, the analysis of non-primary sectors (Table 4.11) presents a stark contrast. Infrastructure investments generally exhibit a negative relationship with exports, particularly in the construction, telecommunication, textile, and industrial sectors. Here, construction investment (coefficient= -0.1275) is negatively significant with exports, at the 5% level. This negative relationship suggests a substitutability effect, where Chinese infrastructure investments in the construction sector might not directly enhance exports from this sector to China. Instead, these investments could be aimed at bolstering domestic infrastructure within African countries, potentially leading to increased local capacity and productivity but not necessarily resulting in increased exports to China. This finding aligns with a horizontal approach of the new trade theory, where investments are geared towards serving the local market rather than exporting goods back to the investor country (Markusen, 1984). This indicates that although Chinese investments play a significant role in developing infrastructure in Africa, their immediate effect on enhancing export performance within the construction sector may be limited. Moreover, the telecommunication sector estimated coefficient (-0.0371) is

significant and negative at the 10% level. This indicates that, much like in the construction sector, Chinese investments in telecommunications infrastructure within Africa tend to have a substitutive rather than complementary relationship with exports from this sector. The investment likely focuses on developing the domestic telecommunication infrastructure, enhancing connectivity and service provision for local consumers and businesses, rather than facilitating exports to China. This outcome corroborates the horizontal approach of the new trade theory, emphasizing investments aimed at tapping into local markets (Helpman and Krugman, 1985). In the same vein, the coefficients of textile and industrial are-1.4137 and -1.1541, respectively, both significant, also indicate a substitution effect. This suggests that Chinese infrastructure investments in these sectors may not necessarily augment exports to China but could instead be aimed at serving the domestic markets of the host African countries, aligning with the horizontal integration approach of new trade theory (Markusen, 1984). Notably, the machinery sector shows an insignificant relationship, possibly indicating a more complex interaction of factors influencing export performance in this sector.

These sectoral disparities are further illuminated through the control variables. GDP's positive significance across sectors emphasizes the universal importance of market size in export performance, aligning with classical trade theories that advocate for scale economies in international trade (Krugman, 1979). Trade openness exhibits varied effects, underscoring the differential impact of liberalization policies on sector-specific export capabilities. Intriguingly, institutional quality generally shows a negative association across primary sectors, suggesting that the less stringent regulatory environments might facilitate export activities in these resource-intensive sectors, a finding that nuances the conventional wisdom regarding the positive role of institutions in trade (Rodrik et al., 2004).The significant coefficients of population across both

primary and non-primary sectors underline the role of labour force in supporting export capacities, reflecting demographic advantages in production and export activities. Distance, exhibiting varied significance, points to the logistical and spatial challenges inherent in international trade, resonating with the gravity principle on trade (Anderson and van Wincoop, 2003).

The Inverse Mills Ratio's significance across analyses justifies the Heckman model's application, addressing potential selection biases and ensuring the robustness of the findings. This methodological precision provides detailed insight into the intricate relationship between China's OII and sector-specific export performance in Africa. It unveils a complex array of motivations and outcomes influenced by each sector's distinct features.

**Table 4.10 Impact of Infrastructure investment on export performance of primary sectors in Africa**

| | (1) Agriculture Exports | (2) Metals Exports | (3) Energy Exports | (4) Chemical Exports |
|---|---|---|---|---|
| *Agriculture investment* | 0.2259*** | | | |
| | (0.0201) | | | |
| *Metals investment* | | 0.5999*** | | |
| | | (0.1407) | | |
| *Energy investment* | | | 0.0238* | |
| | | | (0.0124) | |
| *Chemical investment* | | | | 0.9562 |
| | | | | (1.3529) |
| *Gross domestic product* | -0.0025 | 0.1658* | 0.2315*** | 0.0477 |
| | (0.0021) | (0.0891) | (0.0518) | (0.0972) |
| *Trade openness* | -0.0001 | 0.0015 | -0.0002 | 0.0022** |
| | (0.0000) | (0.0009) | (0.0006) | (0.0010) |
| *Institutional quality* | 0.0061 | -0.4074*** | -0.3585*** | -0.4362*** |
| | (0.0038) | (0.0797) | (0.0636) | (0.0847) |
| *Population* | 0.0158*** | 0.5090*** | 0.1928*** | 0.5274*** |
| | (0.0029) | (0.1005) | (0.0483) | (0.1060) |
| *African domestic investment* | -0.0004 | 0.0054 | 0.0060*** | 0.0050 |
| | (0.0003) | (0.0037) | (0.0020) | (0.0039) |
| *Distance* | 0.0593*** | 2.1611*** | 0.8926** | 1.9107*** |
| | (0.0203) | (0.6223) | (0.4180) | (0.6398) |
| *Inverse Mills Ratio* | 0.0061 | 0.5120** | 0.2050** | 0.5518** |
| | (0.0068) | (0.2020) | (0.0940) | (0.2185) |
| Constant | -0.7647*** | -8.7159*** | -3.4471*** | -5.8969*** |
| | (0.2054) | (7.3846) | (4.7918) | (7.5412) |
| Observations | 644 | 644 | 644 | 644 |
| R-squared | 0.348 | 0.340 | 0.147 | 0.256 |

Note: This table displays the results of the second-stage Heckman regression analysis focusing on the export performance of four primary industry sectors. All explanatory and control variables have a one-year lag. The Inverse Mills Ratio, derived from the Probit regression, is included. Additionally, year, industry, and country dummies are incorporated into the model. Robust standard errors are indicated within parentheses. Refer to Appendix 1 for the definitions and measurements of variables. The symbols ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 4.11 Impact of Infrastructure investment on export performance of non-primary sectors in Africa**

| | (1) Machinery exports | (2) Textile Exports | (3) Industrial Exports | (4) Construction Exports |
|---|---|---|---|---|
| *Machinery investment* | 0.9780 | | | |
| | (2.1973) | | | |
| *Textile investment* | | -1.4137*** | | |
| | | (0.5423) | | |
| *Industrial investment* | | | -1.1541** | |
| | | | (0.4734) | |
| *Construction investment* | | | | -0.1275** |
| | | | | (0.0586) |
| *Gross domestic product* | 0.1907** | 0.2205*** | 0.1934** | 0.2055** |
| | (0.0870) | (0.0801) | (0.0770) | (0.0881) |
| *Trade openness* | 0.0035** | -0.0002 | 0.0023* | 0.0014 |
| | (0.0014) | (0.0009) | (0.0012) | (0.0010) |
| *Institutional quality* | -0.2822*** | -0.8191*** | -0.4985*** | -0.5458*** |
| | (0.1053) | (0.1159) | (0.1074) | (0.1029) |
| *Population* | 0.5035*** | 0.5029*** | 0.7713*** | 0.3290*** |
| | (0.1184) | (0.0980) | (0.1208) | (0.0966) |
| *African domestic investment* | -0.0015 | 0.0140*** | 0.0091** | 0.0036 |
| | (0.0040) | (0.0038) | (0.0037) | (0.0039) |
| *Distance* | 0.8882** | 0.0728 | -0.0741 | 0.8943** |
| | (0.3673) | (0.3262) | (0.3187) | (0.3721) |
| *Inverse Mills Ratio* | 0.2228 | 0.6924*** | 1.0663*** | -0.0025 |
| | (0.2177) | (0.2165) | (0.2393) | (0.2013) |
| Constant | -17.2846*** | -11.0424** | -14.1511*** | -14.4700*** |
| | (4.8667) | (4.3969) | (4.1448) | (4.9714) |
| Observations | 644 | 644 | 644 | 644 |
| R-squared | 0.208 | 0.271 | 0.333 | 0.177 |

Note: This table displays the results of the second-stage Heckman regression analysis focusing on the export performance of four non-primary industry sectors. All explanatory and control variables have a one-year lag. The Inverse Mills Ratio, derived from the Probit regression, is included. Additionally, year, industry, and country dummies are incorporated into the model. Robust standard errors are indicated within parentheses. Refer to Appendix 1 for the definitions and measurements of variables. The symbols ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

**Table 4.11 Impact of Infrastructure investment on export performance of non-primary sectors in Africa (continued)**

| | (1) Financial exports | (2) Transport exports | (3) Travel Exports | (4) Entertainment exports | (5) Logistics Exports | (6) Telecommunication exports |
|---|---|---|---|---|---|---|
| *Financial investment* | 0.5409 | | | | | |
| | (0.4976) | | | | | |
| *Transport investment* | | -0.0124 | | | | |
| | | (0.3010) | | | | |
| *Travel investment* | | | -4.6111 | | | |
| | | | (4.9449) | | | |
| *Entertainment investment* | | | | -0.5043 | | |
| | | | | (3.6021) | | |
| *Logistics investment* | | | | | -0.1464 | |
| | | | | | (1.0589) | |
| *Telecommunication investment* | | | | | | -0.0371* |
| | | | | | | (0.0214) |
| *Gross domestic product* | 0.2129*** | 0.2120** | 0.2231*** | 0.1921** | 0.2137*** | 0.1911** |
| | (0.0819) | (0.0881) | (0.0802) | (0.0872) | (0.0817) | (0.0873) |
| *Trade openness* | 0.0022** | 0.0015 | -0.0002 | 0.0035** | 0.0021** | 0.0035** |
| | (0.0010) | (0.0010) | (0.0009) | (0.0014) | (0.0010) | (0.0014) |
| *Institutional quality* | -0.6526*** | -0.5419*** | -0.8222*** | -0.2805*** | -0.6502*** | -0.2792*** |
| | (0.1041) | (0.1027) | (0.1164) | (0.1048) | (0.1040) | (0.1047) |
| *Population* | 0.5566*** | 0.3276*** | 0.5021*** | 0.5058*** | 0.5575*** | 0.5066*** |
| | (0.1067) | (0.0968) | (0.0984) | (0.1173) | (0.1063) | (0.1175) |
| *African domestic investment* | 0.0041 | 0.0030 | 0.0143*** | -0.0015 | 0.0040 | -0.0017 |
| | (0.0038) | (0.0039) | (0.0038) | (0.0039) | (0.0038) | (0.0039) |
| *Distance* | 3.2413*** | 0.9120** | 0.0811 | 0.8996** | 3.2541*** | 0.8924** |
| | (0.5302) | (0.3746) | (0.3262) | (0.3688) | (0.5263) | (0.3699) |
| *Inverse Mills Ratio* | 0.5921*** | 0.0137 | 0.6985*** | 0.2190 | 0.5912*** | 0.2193 |
| | (0.2195) | (0.2015) | (0.2178) | (0.2183) | (0.2196) | (0.2189) |
| Constant | -0.2888*** | -4.6876*** | -1.1383** | -7.4203*** | -0.4193*** | -7.3569*** |
| | (6.6979) | (4.9853) | (4.3986) | (4.8626) | (6.6515) | (4.8664) |
| Observations | 644 | 644 | 644 | 644 | 644 | 644 |
| R-squared | 0.230 | 0.174 | 0.271 | 0.208 | 0.230 | 0.208 |

Note: This table displays the results of the second-stage Heckman regression analysis focusing on the export performance of six non-primary industry sectors. All explanatory and control variables have a one-year lag. The Inverse Mills Ratio, derived from the Probit regression, is included. Additionally, year, industry, and country dummies are incorporated into the model. Robust standard errors are indicated within parentheses. Refer to Appendix 1 for the definitions and measurements of variables. The symbols ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

### 4.4.6 Robustness Tests

To verify the stability of our findings, we perform a robustness test on our initial results presented in Table 4 by introducing an alternative explanatory variable, "Debt to China." This data is obtained from the China-Africa Research Initiative database. The model is specified as follows:

$$EXP_{it} = \beta_0 + \beta_1 DEBT_{it-1} + \beta_2 GDP_{it-1} + \beta_3 NR_{it-1} + \beta_4 INQ_{it-1} + \beta_5 INFLA_{it-1} + \beta_6 DIST_{it-1} + \beta_7 POP_{it-1} + \beta_8 TO_{it-1} + \beta_9 ADV_{it-1} + \beta_{10} IMR + \mu_i + \varepsilon_{it} \quad (3)$$

The robustness analysis that assesses the effects of African nations' debt to China on their export performance to China and on China's reported imports from Africa corroborates our initial results: Chinese financial involvements have a positive impact on trade dynamics, endorsing a resource-seeking motive. Specifically, the positive coefficients for debt to China shown at 0.0002 for African exports to China and 0.0003 for China's imports from Africa, both significant at the 1% level, emphasize these debts' critical role in promoting exports. This is consistent with the literature that discusses the strategic use of debt to secure resources needed by the investing country, supporting the notion that China's investments and associated debts are aimed at bridging its resource gap (Alden, 2007; Brautigam, 2009).Moreover, the variance in the significance and direction of control variables like GDP and natural resources across the two models highlights the nuanced relationship between economic factors and trade flows, emphasizing the critical role of resource endowments and economic size in shaping the export-import dynamics between Africa and China.

**Table 4.12 Robustness test: Impact of Debt to China on export performance of countries in Africa**

| | Africa exports to China | China reported import from Africa |
|---|---|---|
| *Debt to China* | 0.0002*** | 0.0003*** |
| | (0.0001) | (0.0001) |
| *Gross domestic product* | 0.2001** | 0.0813 |
| | (0.0946) | (0.0917) |
| *Natural resource* | 4.9446*** | 0.0651*** |
| | (0.7679) | (0.0100) |
| *Trade openness* | -0.1918** | 0.0007 |
| | (0.0905) | (0.0010) |
| *Institutional quality* | -0.0629 | 0.5896*** |
| | (0.1121) | (0.1642) |
| *Inflation rate* | 0.9116 | 0.0001 |
| | (0.6274) | (0.0010) |
| *Population* | 0.6681*** | 1.3546*** |
| | (0.1377) | (0.2329) |
| *African domestic investment* | 0.5516 | 0.0019 |
| | (0.4041) | (0.0042) |
| *Distance* | -0.4833 | 2.7628*** |
| | (0.3439) | (0.8004) |
| *Inverse Mills Ratio* | 1.0040*** | 2.6675*** |
| | (0.2749) | (0.5119) |
| Constant | -8.4237* | -9.3584*** |
| | (5.0431) | (1.1388) |
| Observations | 644 | 644 |
| R-squared | 0.376 | 0.400 |

Notes: This table reports the Heckman second stage regression results in which the dependent variables are Africa export to China and China reported import from Africa. All explanatory and control variables are lagged by one year. Inverse Mills Ratio computed from the Probit regression is added. Interactive terms are introduced in column 2. Year, industry and country dummies are added. Robust standard errors are in parentheses. See the Appendix for definition and measurement of variables. ***, ** and * denote the statistical significancelevel at 1%, 5%, and 10%, respectively.

Moreover, in Table 4.5, we apply the Generalised Method of Moments (GMM) technique as the foundational approach for our analysis to assess the effectiveness of Heckman's two-stage model. As Arellano and Bover (1995) and Blundell and Bond (1998) discussed, GMM can address estimation issues such as unobservable heteroskedasticity, simultaneity, and dynamic endogeneity. It achieves unbiased and consistent results using valid internal instruments during the estimation process. Consequently, our study utilizes the system GMM, regarded as particularly effective due to its robustness against endogeneity, simultaneity, and heterogeneity. The model

is specified as follows:

$$EXP_{it} = \beta_0 + \beta_1 EXP_{it-1} + \beta_2 Investment_{it-1} + \beta_3 GDP_{it-1} + \beta_4 NR_{it-1} + \beta_5 INQ_{it-1} + \beta_6 INFLA_{it-1} + \beta_7 DIST_{it-1} + \beta_8 POP_{it-1} + \beta_9 TO_{it-1} + \beta_{10} ADV_{it-1} + \mu_i + \varepsilon_{it} \quad (4)$$

The results of the Generalized Method of Moments (GMM), reinforce the baseline findings that Chinese infrastructure investment positively influences the export performance of African countries, further underlining the complementary nature of such investments to African exports. The GMM results, shown in Table 4.13 (column one), demonstrate that infrastructure investment (coefficient= 0.0574) bolsters exports from African countries to China at the 1% significance level. This finding is consistent with existing literature, emphasizing the role of Chinese OII in facilitating export growth in recipient countries by enhancing infrastructure and connectivity (Xin & Gyan, 2020). Notably, the RFI arrangement variable (in column 2), indicating the presence of resources-for-infrastructure deals (coefficient= 0.6566), shows a significant and positive impact on exports at the 5% level. This supports the hypothesis that RFI deals, (servicing infrastructure loans with natural resources), play a crucial role in boosting exports, aligning with the resource-seeking motives of Chinese investments in the continent.

The analysis of control variables reveals similar patterns to those observed in the Heckman model, with GDP per capita positively affects exports to China, suggesting that larger economies have a higher capacity to export. Institutional quality negatively impacts exports, indicating potential challenges in higher regulatory environments, though it is noteworthy that this variable shows a significant negative effect on exports, emphasizing the complexity of institutional impacts on trade. Model diagnostics confirm the validity of the GMM estimations. The Hansen test of overidentifying

restrictions and AR (2) test for second-order serial correlation suggest that the instruments used in the analysis are appropriate and that there is no second-order autocorrelation, affirming the reliability of the results.

**Table 4.13 Robustness test: impact of Chinese infrastructure investment on export performance of countries in Africa using GMM**

| | (1) | (2) |
|---|---|---|
| *Export lagged* | 0.8613*** | 0.8962*** |
| | (0.0387) | (0.0366) |
| *Infrastructure investment* | 0.0574*** | |
| | (0.0257) | |
| *Resource for infrastructure (RFI)* | | 0.6566** |
| | | (0.3022 |
| *Gross domestic product* | 0.1922** | 0.1856** |
| | (0.0872) | (0.0912) |
| *Natural resource* | -0.8967 | -0.7210 |
| | (0.6543) | (0.7915) |
| *Trade openness* | 0.0486 | -0.0110 |
| | (0.0887) | (0.0956) |
| *Institutional quality* | -0.2365** | -0.2348* |
| | (0.1086) | (0.1215) |
| *Inflation rate* | -0.0188 | 0.0926 |
| | (0.3463) | (0.3336) |
| *Population* | 0.7601 | -1.1539 |
| | (0.4702) | (2.4147) |
| *African domestic investment* | 0.0730* | 0.0887 |
| | (0.0423) | (0.0605) |
| *Distance* | 0.2962 | 0.1894 |
| | (0.2426) | (0.3209) |
| Model Diagnostics: | | |
| AR (1) | -2.13 | -2.21 |
| | (0.033) | (0.027) |
| AR (2) | -0.08 | 0.65 |
| | (0.938) | (0.573) |
| Hansen p-value | 23.08 | 25.07 |
| | (0.285) | (0.158) |
| Observations | 644 | 644 |
| Number of groups | 46 | 46 |
| Number of instruments | 44 | 44 |

Note: This table presents two-step System GMM results, with the dependent variable being exports. All explanatory variables (infrastructure investment and RFI) and control variables are lagged by one year. Year, industry, and country dummies are included. Robust standard errors are shown in parentheses. Refer to the Appendix for variable definitions and measurements. AR (1) and AR (2) tests examine second-order serial correlation, with the null hypothesis of no serial correlation. The Hansen test assesses overidentifying restrictions, distributed asymptotically as chi-square under the null hypothesis of instrument validity. Lagged two or more terms of the dependent, independent, and control variables serve as instruments in the estimations. ***, **, and * signify statistical significance levels of 1%, 5%, and 10%, respectively.

## 4.5 Discussion and Conclusion

Our study explores the relationship between Chinese infrastructure investment and its influence on the export performance of various African industries and countries. By examining whether Chinese investments complement or substitute African exports, we uncover nuanced relationships shaped by both resource-seeking and market-seeking motives. The study differentiates Chinese infrastructure investment from traditional FDI approaches, emphasizing its unique role in enhancing connectivity, facilitating regional economic activity, and sometimes utilizing access to resources as repayment for infrastructure developments.

Based on our empirical findings, we derive several significant policy implications. Notably, we found a positive association between Chinese infrastructure investments and exports within primary industries such as agriculture, metals, and energy. This result suggests a predominant resource-oriented motive in such investments. This finding not only confirms the resource-seeking behaviour of Chinese SOEs in Africa but also highlights the potential of these investments to serve as catalysts for export growth in resource-rich African countries. Conversely, in non-primary sectors (including textile, industrial, construction, and telecommunications), a substitutability effect was noted. This suggests that Chinese investments in these areas may primarily target serving the domestic markets within African countries rather than boosting exports to China. This distinction underscores the diverse objectives of Chinese investments and the need for tailored policy responses.

The insights gained from this analysis underscore the importance of crafting informed policies that both leverage the benefits of Chinese infrastructure investments and mitigate potential drawbacks. For resource-rich countries, policies could focus on

ensuring that such investments contribute to sustainable economic development, avoiding the pitfalls of the resource curse by diversifying the economy beyond natural resource exports. For countries with significant non-primary sectors, there is a need to ensure that Chinese investments do not overshadow local firms but rather integrate them into the value chain, enhancing local industry competitiveness and export capacity. The findings suggest that African countries could benefit from adopting broader economic strategies that encompass not just attracting foreign investment but also building local capacity, diversifying the economic base, and fostering innovation and technology transfer.

It is crucial to note that our analysis does not cover all possible impacts and implications of Chinese investments, given the absence of industry-specific factors such as research and development intensity, firm size, and labor market conditions. Therefore, while our conclusions offer valuable insights, they represent a starting point for further detailed investigations.

In conclusion, while Chinese infrastructure investments in Africa show a clear complementary relationship with exports in primary sectors, indicating a strategic alignment with the continent's resource endowments, the scenario is more complex in non-primary sectors. These findings call for nuanced, sector-specific policy frameworks that not only attract and manage foreign investments effectively but also safeguard and promote sustainable economic growth and development across Africa.

# CHAPTER 5
# CHINA'S INFRASTRUCTURE INVESTMENT IN AFRICA: DEBT TRAP PARADIGM

## 5.1 Introduction

The radical economic downturn occasioned by the COVID-19 pandemic has placed numerous African countries in a precarious fiscal situation characterised by dwindling revenue streams and escalated domestic expenditures. To mitigate these financial challenges, these nations have increasingly turned to external borrowing, exacerbating an already pressing debt crisis (Ndulu & O'Connell, 2021). Prior to the pandemic, the total external debt of African countries saw a significant rise from approximately $305 billion in 2010 to over $665 billion by the end of 2019, marking over a 218 percent increase. Between 2010 and 2018, the debt ratio to gross domestic product (GDP) rose significantly from 40% to 59%, a trend that has garnered significant attention (World Bank, 2019). Similarly, the International Monetary Fund (IMF) noted in 2018 that most sub-Saharan African nations exceeded the 60% debt ratio-to-GDP benchmark established by the African Monetary Co-operation Programme (AMCP) for developing countries. This action has severely limited these countries' ability to finance budget deficits and new development projects (Manasseh et al., 2022). As such, debt unsustainability is imminent if it has yet to occur.

The drive towards achieving Sustainable Development Goals (SDGs) has notably led governments to seek external support for financing budget deficits and infrastructure-gap initiatives, primarily in the form of loans. This pursuit, however, has seen debt levels in African countries surge to alarming rates, impeding the realisation of SDG targets (Osakede & Adeleke, 2022). Consequently, the infrastructure gap is a significant factor identified in the literature for the debt upsurge (Deloitte, 2020). Interestingly, China has

been recognised as a potential actor in bridging this gap. This is because of the influx of Chinese development finance into the continent. Several researchers assert that the Chinese have become the largest supplier of official development finance and the second-largest private investor in Africa (AidData, 2019; Brautigam & Hwang, 2016; UNCTAD, 2019). These financial deals look so attractive that the majority of the governments in Africa have engaged with the Chinese via infrastructure projects. From 2005 to 2019, China engaged in nearly 579 infrastructure projects, highlighting its considerable role in funding development across Africa (CGIT, 2020).

Reports indicate that, as of the end of 2020, nearly 45% of total government debt in Africa was attributed to obligations to China, illustrating the pivotal nature of Chinese Overseas Direct Investment (ODI) in the continent's financial dynamics (Kiran, 2021). Hence, the upsurge in African government borrowing has been attributed to the influx of China's OII on the continent. These financial commitments include a variety of supports such as loans, grants, and resources for infrastructure (RFI), with loans being a substantial component of China's OII in Africa (Pigato & Tang, 2015; Brautigam & Gallagher, 2014; Strange et al., 2013). Thus, a nuanced understanding of China's aid to the debt landscape in Africa, particularly in the context of infrastructure development and its economic ramifications, forms the core focus of this study.

In theory, government debt has been established as one of the parameters affected by this type of investment. Scholars argue that this type of investment is a form of globalisation that affects macroeconomic parameters such as economic advancement, inequalities, tax policies, and government debt, among others, in advanced and emerging countries (Bataka, 2021; Baris, 2019). The relationship between external investment and government debts remains inconclusive. Hyperglobalists and transformationalists predict positive outcomes. However, sceptics and dependency theorists think otherwise.

To the researcher's knowledge, in the context of Africa debts, there are no studies on the debt trap paradigm in empirical journals. However, there have been observational research by scholars about the amount of debt that some African nations owe to China, particularly in relation to infrastructure projects. Scholars, including Were (2018), relate the rise in African government debt to the upsurge of Chinese OII, particularly the resource for infrastructure (RFI) model. The surge in China's OII is because most of China's OII includes debt finance, typically connected with resources. Brautigam and Gallagher (2014) state that natural resources repay approximately 56% of infrastructure loans. As a result, infrastructure loans become more appealing to the host country, thereby increasing the debt burden (Were, 2018). Carmody (2020) contends that the relationship is one of dependency rather than a debt trap because development projects will almost certainly necessitate large external borrowings. More so, Gangte (2020) argues that critics' use of Hambantota port evidence to support their narratives can be attributed to internal structural concerns rather than debt traps. As a result, Brautigam (2020) claims that the narrative needs to be clarified among academics, the media, and the public.

What is the essence of the debate without systematic evidence on Chinese debt trap diplomacy in Africa? Through this lens, we endeavour to unravel empirical findings on the complexities of the Chinese-African infrastructure interaction and assess its broader impact on the continent's quest for debt sustainability. We empirically investigate the China-Africa OII interaction through the debt sustainability channel using experimental research. We also apply the exclusion restriction method and a specialised machine learning algorithm to analyse the debt trap paradigm.

This research enhances the existing body of knowledge through two distinct contributions. Firstly, we measure the infrastructure interactions using the amount of

investment widely used in literature and new measures: a dummy variable depicting the recipients of China's infrastructure investment and RFI (export-oriented investment). These conjure traditional theories on globalisation. These variables are paramount because any relationship bound by foreign investment is a significant factor in achieving sustainable economic development (Azman-Saini & Law, 2010; Chowdhury & Mavrotas, 2006). The RFI is a unique form of commodity-based investment as it involves servicing the infrastructure debt with natural resources instead of actual money (Brautigam & Gallagher, 2014). Secondly, we assess the impact of China-Africa interaction employing instrumental method and specialised machine learning algorithms. The algorithm is used to predict the debt-trap crisis of African countries. Goto et al., 2018 and Barboza et al., 2017 assert that this algorithm improves prediction accuracy over traditional models and is suitable for classification studies.

We utilize a dataset for 48 African nations from 2005 to 2019. The results obtained from Heckman's two-stage model and Machine learning algorithm ascertain and predict no debt-trap paradigm for China-Africa infrastructure interaction and government borrowing in Africa. Moreover, when we classify debt into short and long, we also obtain evidence for no debt trap between RFI and short-term debt sustainability. The results conform with the hyperglobalist and transformationalist views on global interaction. Thus, Chinese infrastructure investment is beneficial to Africa as it is a tool for bridging the infrastructure gap, which is a theme under the SDGs.

The remaining sections are organized as follows: The subsequent section covers the literature review and the development of hypotheses. This is followed by a detailed description of the data collection methods, estimation techniques, and how variables were measured. Section 4 presents the empirical findings. The final section, Section 5, provides conclusions for the study.

## 5.2 Related Literatures, Underlying Theory, and Hypotheses

In the International business view, globalization theory provides a social framework that enables the interaction and interconnectedness among entities through capital and foreign investment movements, trade, information communication technology, dissemination of government policies, and uncertainties (Sumner, 2004; Held et al., 1999; Hirst, 1997; Gidden,1990). Based on this assertion, hyperglobalists, skeptics, and transformationalists propound different frameworks of globalisation as a phenomenon. The hyperglobalists believe globalisation is a positive connectivity process characterized by increasing economic growth, prosperity, and other factors contributing to the upsurge, such as democracy and debt sustainability (Friedman, 2000). Here, the positivity emanates from engaging with multinationals and international government organizations. This engagement enhances the technical efficiency of the indigenous companies and sectors primarily through spill-over effects (Ascani & Gagliardi, 2020; Bournakis, Papanastassiou & Pitelis, 2019; Frenz & Letto-Gillies, 2007).

Nevertheless, critics contend that proponents of neoliberalism employ misleading tactics to promote their economic agenda on a global scale, so distorting the actual advantages associated with economic globalisation (Hirst &Thompson, 1996; Chang, 1994). These policies involve natural resources extraction, minimum wage, takeovers, tax law, and pollution law, which entail inequalities, indebtedness, exploitation, and unemployment through the activities of the MNEs (Seabrook, 2002; Chang, 1994). As such, a negative outcome is expected.

From another angle, the transformationalists/postmodernists also believe that the globalist view has been exaggerated, but it is a framework that should be considered in connection with the individual entity's dynamics to construct a formidable global

identity (Held et al., 1999; Giddens, 1990). The essence is characterized by the new political formation and not the spread of democracy alone; as such, the role of government and risk factor consciousness is germane for the positive outcome (Giddens, 1990; Beck, 1992). Beck (1992) asserts that global interaction is associated with risks, including the threat of global pandemics, global warming, inequalities, and indebtedness, among others. The risks evolve from the considerable possibilities that globalisation offers. These risks are the probability of harm arising from social interaction due to technological or economic changes. However, with the consciousness of such risks, they suggest that if the effect of the global interaction is negative, the outcome could be reversed, or at the very least, it could be controlled due to the involvement of the government entity. Therefore, a positive outcome is expected. Consistent with these views, Madalina (2015) agrees that global interconnectedness is associated with a positive or negative effect that invariably leads to a positive or negative outcome.

Interestingly, from the standpoint of political economic theory, dependence theory sheds light on the structural flaws that contribute to the debt trap. One issue identified is dependency on outside funding. This idea assumes there are 'rich nations' (developed) and 'poor,' (underdeveloped states) (Todaro, 2003). According to dependence theory, developing nations are structurally disadvantaged in the global economic system, causing them to rely on rich countries (Amin, 1976; Frank, 1992; Adejumo et al., 2010). Infrastructure deficits are common in poor countries due to structural disadvantages. Governments need to increase their investment in infrastructure to bridge the existing gaps and realize the potential benefits that well-designed and efficient infrastructure can offer. However, because of tight fiscal restrictions, extra government investment is frequently challenging. As a result, many

developing countries, particularly in Africa, borrow money from international financial institutions or more developed countries to fund infrastructure projects, industrialization, or social programmes (Momoh, 2016; Charles & Abimbola, 2018). Critics of dependency theory argue that it reduces the intricate dynamics of global economic interactions to overly simplistic terms. They emphasize that a range of other elements, including national policies, governance quality, and corruption, significantly contribute to the state of a country's debt (Momoh, 2016; Momoh & Hundeyin, 1999).

Supporters of dependence theory define "dependency" as a condition where one economic system is deeply embedded within another, functioning in a manner that perpetually, and possibly increasingly, harms the less-developed partner (Frank, 2013). As a result, resources are taken from developingcountries and moved to industrialised ones to continue economic growth (Amin, 1976; Frank, 2013). The theorist says that the debt crisis in emerging countries can be seen as a result of their reliance on external money for development. These dependencies frequently lead to financial problems when the projects in question do not produce thepromised profits, making repayment impossible. Conditions related to financing can result in a debt load (Aluko &Arowolo, 2010). As a result, many developing countries are locked in a debt cycle, stifling economic progress and increasing reliance on external financing. More specifically, when debt accumulates beyond a nation's ability to repay, a debt crisis is imminent, which can have severe ramifications for the country's economy (Bataka (2019; Osakede & Adeleke, 2022). Thus, from this vantage point, external finance dependency may lead to a debt trap, consistent with the opposingconclusion of globalisation theory.

While the few empirics on this phenomenon also find that global interaction exerts upward/downward pressure on government debt as a risk factor for countries (Ostadi & Ashja,2014; Swamy,2020). A Turkey-based study, Baris (2019) uses the KOF

index as a measure of economic globalization and shows that it exerts upward pressure on the external debt of emerging nations. In contrast, another study by Swamy (2015) documents FDI as a type of economic activity negatively affecting government debt in sovereign nations under study. Moreover, Pyeman, Noor, Mohamad &Yayha (2016) empirically analysed external debt determinants in Malaysia from 1972 to 2012. The authors report FDI as one of the factors and find FDI exerts downward pressure on external debt.

In a similar study, Sinha et al. (2011) categorised nations into middle-income and high-income groups, discovering a negative correlation between foreign direct investment (FDI) and external debt in middle-income nations. In contrast, this association was absent in high-income nations. In a related study, Waheed (2017) examined the factors influencing external debt in countries focused on oil and gas from 2004 to 2013. The findings revealed that while FDI increased government debt in oil and gas-importing countries, it reduced external debt in exporting countries. Further, Bataka (2019) explored the impact of economic globalisation on government debt within African nations using advanced panel data analysis techniques, finding that globalisation initially increases government debt but subsequently reduces it over the long term. As we can see from the above-discussed literature, we can deduce that the evidence remains inconclusive as both positive outcomes (negative sign) and negative outcomes (positive sign) between global interaction and external debt are documented. These studies controlled the effect of global interaction using GDP growthrate, domestic investment, interest rate, inflation rate, exchange rate, institutionalquality, existing infrastructure, trade openness and population growth. We follow the existing literature to understand the phenomenon that holds for China's OII and government debt in Africa using the exclusion restriction method.

Regarding China's OII in Africa, the application of globalisation theory suggests that China-Africa collaboration has numerous benefits ranging from infrastructural development to sustainable economic growth. African nations are eager to participate in China's infrastructure initiatives, recognising their possible advantages. However, traditional development finance literature typically focuses on infrastructure projects primarily carried out by multinational corporations. China's infrastructure projects in Africa differ from private investment because the Chinese government is directly involved in these infrastructure projects. This involvement suggests that African countries involved in China's infrastructure projects would receive China's government direct assistance in finance, technical efficiency, infrastructure development, and labour training (Du, 2016).

Accordingly, Saurav and Kuo (2020) describe these types of direct assistance as effective mechanisms through which foreign investment generates productivity spillovers to local firms of a country. Indeed, Carrai (2021) shows that the Chinese undertaking mega-infrastructure projects in East Africa provide local labour training. In sum, the features mentioned above of Chinese OII in Africa suggest that direct assistance (in finance, technical knowledge, and labour training) offered by the Chinese are viable tools for interaction and noting the importance of government involvement. As such, a positive outcome is expected. Hence, we postulatethe hypothesis based on the outcomes of the interaction on government debt (i.e., no debt-trap).

***Hypothesis 1****: The infrastructure investment interaction between China and Africa may generate positive outcomes on the government debt in Africa.*

However, being involved comes with associated risks (for example, money indebtedness, resources indebtedness, and exploitation, among others) because most of the China-Africa infrastructure investments come in the form of loans, thus adding to

the debt burden (Were,2018). These loans are paid by actual money or resources. Furthermore, it has been documented that the motives of the Chinese matters range from resource-seeking, market-seeking, or influencing government policies (Hendrix, 2020; Amighini *et al*., 2013; Cheung *et al*., 2014; Asiedu & Esfahani, 2001). Considering this, Brautigam and Gallagher (2014) employed an open-source data collection method to analyse infrastructure loans in African and Latin American countries from 2003 to 2011. Their findings reveal that approximately 56% of these loans in African nations were settled through commodities, typically natural resources, during the same period. A significant portion of these repayments for commodity-based debts is linked to infrastructure initiatives spearheaded by China, indicating a clear resource-seeking intent behind China's OII.

The debt burden is significant when considering that the primary aim of China's infrastructure investments is to secure natural resources (Were, 2018). Ideally, the African government would be geared to interact using the RFI model rather than non-RFI because it is easierand less risky to repay by the available natural resources than sourcing revenue to repayor waiting for the infrastructure yielding period. A negative outcome is expected on thisground because the more quest for RFI, the more loans. Hence, we can hypothesize that:

***Hypothesis 2****: The RFI interaction between China and Africa may generate negative outcome on the government debt in Africa.*

## 5.3 Methodology

### 5.3.1 Data and Sample

We sourced data on our primary explanatory variable from the China Global Investment Tracker (CGIT) for our country-level study. This dataset encompasses Chinese infrastructure investments received by forty-six African countries. However, it is

pivotal to recognize the inherent selectivity in our sample. The non-random nature of this selection could potentially skew our findings, necessitating a robust methodological approach to mitigate such bias.

In addressing this issue, we adopted the Heckman two-stage correction method. This approach allows us to adjust for the non-randomness by considering both the recipients of Chinese Overseas Infrastructure Investment (OII) and those African countries that did not receive such investments. Consequently, our analysis includes data from all fifty-four African nations to provide a comprehensive overview, aligning with our empirical strategy's requirements.

We paired this OII data with the outcome variable of interest, government debt. However, due to the unavailability of reliable government debt data, six countries—Libya, Mauritania, Equatorial Guinea, Namibia, Seychelles, and South Sudan—were excluded from our analysis. Ultimately, our study encompasses data from forty-eight African countries, incorporating both treatment and control groups, spanning the years 2005 to 2019.

This methodological choice underlines the importance of considering potential selectivity and its implications on our findings. This study explicitly seeks to offer detailed insight into the effects of Chinese infrastructure projects in Africa. By including both recipients and non-recipients of OII, we endeavour to capture the broader effects of such investments on governmental indebtedness, while controlling for inherent sample biases.

### 5.3.2 Model Specification

The interaction between China and Africa through infrastructure projects and

government borrowing in African countries is characterized by non-random selection in the receipt of Chinese OII. This non-randomness introduces a risk of sample selection bias, which, if unaddressed, could lead to misleading conclusions. To mitigate this, we employ the Heckman two-stage technique, which is a widely recognized econometric model for mitigating sample selection bias and addressing endogeneity concerns (Certo, et al., 2016).

The Heckman two-stage technique starts by utilising a probit model in the initial stage to address the selection mechanism (selection equation). Then, in the subsequent stage, we apply an OLS regression to evaluate the variable of interest (the outcome equation). The econometric justification for using the Heckman model lies in its capacity to adjust for sample selection bias and reduce endogeneity concerns by incorporating exclusion restriction (ER) variables. A valid ER variable is one that influences the selection equation but has no direct effect on the outcome variable. The introduction of such variables helps reduce multicollinearity among predictors and the correlation between error terms, as argued by Heckman and Vytlacil (2001).

For the selection equation, we identify natural resources and the One Belt Initiative as suitable exclusion restriction variables. Natural resources attract foreign investments, particularly from resource-seeking entities like China, without directly affecting government borrowing patterns, thus serving as a strategic factor in the selection of investment recipients (Amighini et al., 2013). Furthermore, Arezki and Bruckner (2012) discuss the link between natural resource endowments and the inflow of foreign direct investments, emphasizing the crucial role that natural resources play in drawing investments. However, they do not directly influence fiscal policy results like government borrowing. Similarly, Cheung et al. (2012) discuss the strategic

motivations behind China's investments abroad, including the BRI, and highlighting the geopolitical and economic considerations that guide China's selection of investment destinations. These strategic considerations make the BRI a suitable instrument because they affect investment flows without directly influencing a country's fiscal policies or debt levels. Moreover, Du and Zhang (2018) analyze the BRI's impact on trade and investment flows, underscoring the initiative's role in shaping investment patterns without directly affecting fiscal outcomes. These variables are ideal for our model because they fulfill the critical criteria for exclusion restrictions by impacting the likelihood of receiving investment (selection variable) while remaining uncorrelated with the outcome variable (government borrowing), thereby providing a robust solution to address potential endogeneity and selection bias in our econometric analysis.

The model is specified as follows:

**First Stage: Selection Equation**

The first stage models the probability of an African country being a recipient of Chinese infrastructure investment as a function of several macro-economic variables, including GDP growth rate, natural resources, institutional quality, existing infrastructure, trade openness, domestic investment, external debt, legal origin, interest rate, inflation rate, exchange rate, and the One Belt Initiative. The equation is specified as follows:

$$Probability\ (Recipient_{it} = 1) = \beta_0 + +\beta_1 GDP_{it} + \beta_2 NR_{it} + \beta_3 INQ_{it} + \beta_4 TO_{it} + \beta_5 LO_{it} + \beta_6 INF_{it} + \beta_7 ADV_{it} + \beta_8 INFL_{it} + \beta_9 ED_{it} + \beta_{10} EXC_{it} + \beta_{11} INR_{it} + \beta_{12} BRI_{it}\ \mu_i + \varepsilon_{it} \quad (1)$$

The explained variable is binary ($Recipient_{it}$), assigned a value of 1 if an African country has received infrastructure funding from China and 0 otherwise. The instruments used for exclusion restrictions include natural resources and the One Belt

initiative. $\mu i$ represents the error specific to the individual, while $\varepsilon it$ denotes the standard error component.

**Second Stage: Outcome Equation**

The second stage evaluates how interactions between China and Africa in infrastructure affect governmental borrowing, accounting for typical factors influencing government debt. The Lambda derived from the first stage is incorporated to address selection bias.

$$GB_{it} = \beta_0 + \beta_1 Recipient_{it} + \beta_1 GDP_{it} + \beta_2 INQ_{it} + \beta_3 TO_{it} + \beta_4 LO_{it} + \beta_5 INF_{it} + \beta_6 ADV_{it} + \beta_7 INFL_{it} + \beta_8 ED_{it} + \beta_9 EXC_{it} + \beta_{10} INR_{it} + \beta_{11} IMR + \mu_i + \varepsilon_{it} \quad (2)$$

Where $Recipient_{it}$ is proxied by two variables: infrastructure investment and resource-for-infrastructure. *GB* is the external debt to GDP ratio. *INQ* is the institutional quality, *POPU* represents the population growth. *TO* is the trade openness, *GDP* is the GDP growth rate, *ADV* is the Africans' domestic investment, *EXC* is the real effective exchange rate, *LO* is the legal origin, *INR* is the rate of interest, *INFL* represent the rate of inflation, $\mu_i$ is the individual specific error component and $\varepsilon_{it}$ is the basic error component. This specification accounts for both the decision to receive investment (the selection equation) and the effect of such investment on government borrowing (the outcome equation). A detailed explanation of variables and their relevance to the study is provided in the next section and appendix.

### 5.3.3 Description of Variables

The analysis of the link between infrastructure investment and governmental borrowing in Africa hinges on the careful selection of variables grounded in well-established economic theories and empirical evidence. For example, the choice of government borrowing (GB) as a dependent variable, quantified as external debt to China relative to GDP, is guided by existing research on debt sustainability and fiscal policy.

Fundamental studies, like those by Reinhart and Rogoff (2010), emphasize the importance of debt-to-GDP ratios in evaluating a nation's fiscal burden and its impact on economic stability and growth. The analysis incorporates both short-term and long-term debt, based on the insights from Kumar and Woo (2010), who argue for the need to differentiate between these types of debt due to their distinct effects on an economy's susceptibility to financial crises. The short-term Debt to GDP ratio reflects debt obligations due within a year relative to GDP. In contrast, the Long-term Debt to GDP ratio measures debt obligations due after one year, also as a percentage of GDP. These debt figures are compiled from the International Debt Statistics Database.

The choice of infrastructure investment interaction as the primary explanatory variable is supported by Calderón and Serven (2004) and Straub (2008), who underscore the significant impact of infrastructure investments on economic development outcomes. The three interaction indicators used to proxy for infrastructure investment from China encapsulate the multifaceted nature of such investments, including their scale, presence, and specific arrangements like infrastructural loans for the RFI deal. This approach aligns with studies by Bräutigam and Gallagher (2014), who investigate the effect of China’s infrastructure financing on recipient countries' development trajectories, emphasizing the need to consider the heterogeneity of investment types and their targeted outcomes. Furthermore, distinguishing between various kinds of infrastructure corresponds with the detailed strategy Brautigam (2009) recommends for analyzing China's investment tactics in Africa, emphasizing the diversity and intricacy of China's involvement. The information comes from the CGIT database. The data are sourced from the CGIT database.

The incorporation of control variables such as GDP growth rate, domestic

investment, interest rate, and institutional quality is informed by the work of Baris (2019), Bataka (2019), Gargouri & Keantini (2016), and Swamy (2015), which collectively suggest these factors play pivotal roles in influencing government borrowing behaviors. For example, the GDP growth rate and domestic investment are likely to reduce government borrowing by improving a country's capacity to generate revenue and maintain economic growth without heavy dependence on external finance. This view is consistent with Rajan and Zingales (1998), who emphasised the role of domestic investment and economic growth in sustaining fiscal stability. In addition, as evidenced by governance indicators, the quality of institutions is vital for analysing borrowing patterns since effective governance typically aligns with prudent fiscal management and borrowing behaviours, as Kaufmann, Kraay, and Mastruzzi (2009) have suggested. Conversely, variables like inflation rate and exchange rate volatility may increase borrowing needs due to their impact on economic stability and the cost of debt service, echoing the insights of Reinhart and Rogoff (2004) on the link among, exchange rate, inflation rate, and foreign debts.

This study also introduces variables specific to the African context and the peculiarities of Chinese investment, such as natural resource endowments and Belt Road Initiative (BRI), to capture the strategic motives behind borrowing and investment decisions. The inclusion of the BRI variable is rooted in the strategic developmental philosophy espoused by China, emphasizing infrastructure's pivotal role in regional connectivity and economic development, as elaborated by Dollar (2019). Natural resources rent as a proxy for a resource-seeking motive reflects the work of Asiedu (2006), who discusses how natural resource endowments attract foreign investments, including those aimed at securing these resources. The variable capturing legal origin

is based on La-Porta et al. (1999), who argue that legal traditions influence financial development and, by extension, investment and borrowing practices.

### 5.3.4 Summary Statistics

Table 5.1 shows the descriptive statistics of the variables used in the analysis The data for our outcome variable shows a considerable external debt to China-to-GDP ratio, averaging 0.38. This indicates a high level of debt compared to the economic output of the countries analysed. This level of indebtedness is further categorized into short-term and long-term debt sustainability, with mean values of 0.06 and 0.30, respectively, suggesting a heavier reliance on long-term borrowing. The data underscores the variability and potential vulnerabilities in African economies, with the maximum values indicating instances of unsustainable debt levels. This preliminary observation hints at the complexity of debt sustainability in the continent and the critical role of external financing, particularly from China, in shaping these economic landscapes.

The breakdown for our variables of interest: Chinese infrastructure investment and project loans to Africa reveals a nuanced picture of financial flows and their composition. With an average Chinese infrastructure investment of approximately $459.35 million, nearly half of this amount ($196.41 million) is attributed to project loans. This significant portion underlines the pivotal role of Chinese financing in supporting infrastructure development in Africa. However, the heavy reliance on loans raises concerns about the implications of the investments on debt sustainability. The fact that a small fraction (0.05 on average) of the countries are engaged in commodity-based payment loans suggests a diversity in the financing mechanisms used, which may have different implications for the economic sovereignty and fiscal stability of recipient countries.

The control variables, such as trade openness, domestic investment, and institutional quality, provide a contextual backdrop against which the impact of Chinese investments and loans can be assessed. The mean trade openness to GDP ratio of 71.263

indicates a high level of integration of African economies into the global market, which could be both an opportunity for growth and a vulnerability in times of global economic downturns. The negative mean value of institutional quality (-0.685) points to governance challenges across the continent, which could affect the efficiency and effectiveness of the investments made.

**Table 5.1 Descriptive statistics**

| Variable | Observation | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| External debt to GDP | 720 | 0.38 | 0.37 | 0.00 | 4.16 |
| Short term debt to GDP | 720 | 0.06 | 0.16 | 0.00 | 2.55 |
| Long term debt to GDP | 720 | 0.30 | 0.27 | 0.00 | 2.32 |
| Recipient | 720 | 0.39 | 0.49 | 0.00 | 1.00 |
| Infrastructure Investment ($'million) | 720 | 459.35 | 1023.14 | 0.00 | 8940.00 |
| Resource for Infrastructure | 720 | 0.05 | 0.22 | 0.00 | 1.00 |
| Project Loan (($'million) | 720 | 196.41 | 847.07 | 0.00 | 18817.00 |
| GDP growth rate | 720 | 4.16 | 4.10 | -36.39 | 20.72 |
| African domestic investment | 720 | 21.53 | 11.89 | -0.10 | 77.89 |
| Interest rate | 720 | 5.03 | 9.64 | -78.52 | 52.44 |
| Inflation rate | 720 | 6.81 | 11.64 | -8.97 | 255.30 |
| Real exchange rate ($) | 720 | 38.53 | 48.51 | 0.00 | 142.60 |
| Institutional quality | 720 | -0.69 | 0.61 | -2.45 | 0.85 |
| Existing infrastructure | 720 | 0.80 | 2.24 | 0.00 | 24.20 |
| Population growth | 720 | 2.44 | 0.90 | 0.00 | 6.03 |
| Trade openness | 720 | 66.75 | 40.96 | 0.00 | 348.00 |
| Natural resource | 720 | 11.57 | 11.09 | 0.00 | 59.60 |
| Legal origin | 720 | 0.38 | 0.48 | 0.00 | 1.00 |
| Belt Road Initiative | 720 | 0.18 | 0.38 | 0.00 | 1.00 |

Note: See Appendix for definition and measurement of variables.

Tables 5.2 present the matrix of the correlation and variance inflation factor (VIF) (shown in the appendix). Overall, correlations between variables show an absence of serious multicollinearity among variables. Except for the amount of investment and recipient, the multicollinearity is high; thus, we consider these variables under different regression. In addition, we assessed the VIF test for the variables (refer to the appendix), which indicates that their values fall below the threshold of 10. Consequently, the correlation matrix and the VIF confirm that multicollinearity is not a significant issue in this analysis.

**Table 5.2 Correlation matrix**

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.00 | | | | | | | | | | | | | | |
| 2 | -0.15* | 1.00 | | | | | | | | | | | | | |
| 3 | -0.16* | 0.97 | 1.00 | | | | | | | | | | | | |
| 4 | -0.04 | 0.27 | 0.29 | 1.00 | | | | | | | | | | | |
| 5 | -0.09* | 0.42 | 0.45 | 0.37* | 1.00 | | | | | | | | | | |
| 6 | -0.05 | 0.08 | 0.08 | 0.11* | 0.12 | 1.00 | | | | | | | | | |
| 7 | -0.05 | 0.20 | 0.21* | 0.10* | 0.14 | 0.07 | 1.00 | | | | | | | | |
| 8 | 0.04 | -0.01 | -0.02 | 0.02 | -0.09 | 0.08* | 0.02 | 1.00 | | | | | | | |
| 9 | 0.08* | 0.11* | 0.11 | 0.06 | 0.09 | -0.06 | -0.10* | -0.25* | 1.00 | | | | | | |
| 10 | -0.15* | 0.05 | 0.06 | -0.02 | 0.03 | -0.02 | 0.05 | 0.03 | -0.03 | 1.00 | | | | | |
| 11 | 0.06 | -0.03 | -0.05 | -0.18 | -0.05 | 0.13 | 0.31 | 0.13* | -0.05 | 0.03 | 1.00 | | | | |
| 12 | 0.19 | 0.02 | 0.01 | -0.07 | -0.04 | -0.06 | 0.28* | -0.04 | -0.06 | -0.01 | 0.38* | 1.00 | | | |
| 13 | -0.09 | 0.09* | 0.09* | 0.17 | 0.13* | 0.19* | 0.06 | 0.12* | 0.03 | 0.07 | -0.21* | -0.46* | 1.00 | | |
| 14 | 0.28 | -0.04 | -0.05 | 0.09 | 0.00 | 0.08* | 0.39* | -0.02 | -0.12* | 0.00 | 0.16* | 0.17* | -0.02 | 1.00 | |
| 15 | -0.05 | 0.07 | 0.06 | -0.09 | 0.02 | 0.01 | -0.12* | 0.04 | 0.16* | 0.25* | 0.06 | -0.17* | 0.07 | 0.06 | 1.00 |

See Appendix 2 for definition and measurement of variables. * shows significance at 0.05 level

*1- External debt to GDP 2- Recipient 3.-Infrastructure investment 4- Resource for infrastructure 5-Project loan 6-GDP growth rate*
*7- Real exchange rate 8- Interest rate 9- Inflation rate 10- Exchange rate 11- Natural resources Institutional quality*
*12- Existing infrastructure 13- Population growth 14- Trade openness 15- Legal origin*

## 5.4 Empirical Result

### 5.4.1 The First Stage Estimation: Explaining whether an African Country is a recipient of China's Infrastructure Investment.

Table 5.3 shows the first stage of our estimation, we focus on determining the factors that influence whether an African country becomes a recipient of China's infrastructure investment. Our analysis underscores the pivotal role of exclusion restriction variables, natural resources, and the BRI, which are positively significant at a 1% level with Recipient. Specifically, the inclusion of the BRI in an African country's policy framework markedly increases its likelihood of receiving Chinese infrastructure investment, evidenced by a robust coefficient of 2.8340. This underscores the initiative's substantial impact on investment flows, aligning with China's strategic interests in enhancing connectivity and cooperation across the continent. Similarly, natural resources (coefficient= 0.0375) significantly boost its probability of attracting Chinese infrastructure investments, reinforcing the notion of resource-seeking behaviour by China. These findings not only validate the exclusion restriction's relevance in our model but also spotlight the critical determinants influencing Chinese OII decisions in Africa.

A closer analysis of the model further explains the factors influencing China's infrastructure investments in African nations. The GDP growth rate (coefficient= 0.0498) is positively significant at 1%. This indicates that countries with robust economic growth are preferred targets for Chinese investments, highlighting a tendency to invest in markets with potential for growth. Conversely, external debt and trade openness present negative coefficients at the 10% significance level, indicating a lesser likelihood of investment in highly indebted or excessively open economies, possibly due to perceived risks or

diminishing returns. The existing infrastructure variable, significant at 1% with a coefficient of 0.0953, indicates a preference for countries with infrastructural deficits, possibly aiming at maximizing the developmental impact. Legal origin, with a positive coefficient of 0.3614 at the 5% significance level, suggests a nuanced approach by China, favouring countries with common law systems, likely due to their predictable legal environments. Overall, these statistically significant effects provide a nuanced understanding of Chinese investment strategy in Africa, driven by a mix of economic, legal, and strategic considerations.

Overall, the model performance is acceptable, as the Wald Chi-square test shows. The Wald test of the Probit model is highly significant, showing that explanatory variables' coefficients contribute significantly to the model (Heckman, 1979). Likewise, the reported McFadden pseudo-R-squared is 0.3970, which indicates a reasonably good model fit. In line with that, McFadden (1977) asserts that the rule of thumb for a good McFadden's pseudo-R-squared is usually set between 0.2-0.4.

**Table 5.3 The first stage estimation: Explaining whether an African country is a recipient of China infrastructure investment.**

| VARIABLES | Dependent variable<br>Prob (Recipient=1) |
|---|---|
| *GDP growth rate* | 0.0498*** |
| | (0.0160) |
| *External debt* | -0.0715* |
| | (0.0415) |
| *African domestic investment* | 0.0019 |
| | (0.0077) |
| *Trade openness* | -0.0049* |
| | (0.0027) |
| *Natural resources* | 0.0375*** |
| | (0.0073) |
| *Legal origin* | 0.3614** |
| | (0.1441) |
| *Institutional quality* | -0.0094 |
| | (0.1392) |
| *Exchange rate* | -0.0292 |
| | (0.0662) |
| *Existing infrastructure* | 0.0953*** |
| | (0.0299) |
| *Interest rate* | 0.0035 |
| | (0.0062) |
| *Inflation rate* | 0.0127 |
| | (0.0091) |
| *One belt* | 2.8340*** |
| | (0.2216) |
| Constant | -1.9445*** |
| | (0.2538) |
| Pseudo $R^2$ | 0.3970 |
| Wald $X^2$ | $223.03^{***}$ |
| Observations | 720 |

Note: This table presents the Probit estimation outcomes, with the dependent variable being a binary indicator of whether an African country receives China's infrastructure investment. Year and country indicators are incorporated. Standard errors, robust in nature, are presented in parentheses. The Wald test Chi-squared and pseudo-R-squared values assess the model's overall performance. Please refer to the Appendix for variable definitions and measurements. Significance levels are denoted by ***, **, and *, representing 1%, 5%, and 10%, respectively

### 5.4.2 Effect of China's Infrastructure Investment on Total Government Borrowing of African Countries

Table 5.4 presents the outcomes of the second stage in the Heckman model, incorporating the inverse Mills ratio (Lambda). In this analysis, the explained variable is the ratio of external debt to GDP. In column one, notably, the infrastructure investment has a negative coefficient (-0.0252) at the 5% significance level, suggesting a counter-narrative to the debt-trap concerns. This indicates that Chinese infrastructure investment potentially aids in mitigating government borrowing by fostering economic productivity and integration into global markets, aligning with hyperglobalist and transformationalist perspectives. Contrary to Bataka (2019), this outcome resonates with Pyeman (2016) and Swamy (2015), highlighting the positive externalities of such investments. However, the model reveals an insignificant effect of the resource for infrastructure interaction on government borrowing, indicating no perceptible influence on debt dynamics from this specific investment motive.

In terms of the control variables, the outcomes in the first and second columns are in tandem. The GDP growth rate, exhibiting a noteworthy negative impact (-0.0100) at the 1% significance level, highlights economic expansion as pivotal in decreasing dependence on foreign debt by bolstering government income. Similarly, African domestic investments exhibit a negative association (-0.0063 at the 1% significance level) with government borrowing, indicating that internal investments curtail the need for external borrowing by contributing to infrastructure funding. Conversely, the interest rate positively correlates (0.0035) with government borrowing at the 5% level, indicating that higher interest rates, albeit aimed at attracting investment, could inadvertently heighten

debt burdens when associated with loan-based investments. Inflation rate's positive impact (0.0043) at the 5% level further elucidates the pressure inflation exerts on government borrowing by increasing the cost of debt servicing. Exchange rate appreciations, with a significant negative coefficient (-0.0425) at the 1% level, demonstrate their potential to alleviate government debt by reducing the local currency cost of foreign debt repayments. The existing infrastructure's positive relationship (0.0507) with borrowing at the 1% significance level highlights the infrastructural demands driving government debt, whereas trade openness (0.0013) at the 1% level suggests external borrowing may finance trade deficits. Legal origin's negative coefficient (-0.0623) at the 5% level indicates that countries with common law traditions might experience reduced borrowing needs due to better financial development.

The analysis also acknowledges the non-significant impact of the lambda, suggesting the outcome model is not substantially biased by sample selection issues. This finding is crucial for the interpretative reliability of the observed impacts of Chinese infrastructure investment and other determinants on government borrowing. Despite the lack of significance in the inverse mills ratio, the discussed coefficients provide valuable insights into the multifaceted dynamics influencing government borrowing in the African context, grounded in both theoretical assertions and empirical evidence from existing literature.

**Table 5.4 Effect of infrastructure investment on total government borrowing**

| | (1) | (2) |
|---|---|---|
| *Infrastructure investment* | -0.0252** | |
| | (0.0109) | |
| *Resource for infrastructure* | | -0.0494 |
| | | (0.0487) |
| *GDP growth rate* | -0.0100*** | -0.0096*** |
| | (0.0036) | (0.0037) |
| *African domestic investment* | -0.0063*** | -0.0063*** |
| | (0.0016) | (0.0017) |
| *Interest rate* | 0.0035** | 0.0036** |
| | (0.0015) | (0.0015) |
| *Inflation rate* | 0.0043*** | 0.0044*** |
| | (0.0012) | (0.0012) |
| *Real Exchange rate* | -0.0425*** | -0.0429*** |
| | (0.0124) | (0.0124) |
| *Institutional quality* | -0.0258 | -0.0274 |
| | (0.0266) | (0.0272) |
| *Existing infrastructure* | 0.0507*** | 0.0515*** |
| | (0.0074) | (0.0074) |
| *Population growth* | -0.0082 | -0.0046 |
| | (0.0157) | (0.0157) |
| *Trade openness* | 0.0013*** | 0.0014*** |
| | (0.0004) | (0.0005) |
| *Legal origin* | -0.0623** | -0.0634** |
| | (0.0301) | (0.0301) |
| *Inverse mill ratio* | -0.0115 | 0.0208 |
| | (0.0287) | (0.0236) |
| Constant | 0.3996*** | 0.3228*** |
| | (0.0987) | (0.0933) |
| Observations | 720 | 720 |
| R-squared | 0.233 | 0.229 |

Note: This table presents the results of the Heckman second-stage regression analysis, with the external debt ratio as the dependent variable. Explanatory variables include infrastructure investment and RFI. The real exchange rate is logged. The Inverse Mills Ratio computed from the Probit regression is included. Year and country dummies are incorporated, with robust standard errors reported in parentheses. Please refer to Appendix 1 for variable definitions and measurements. Statistical significance levels are denoted by ***, **, and *, indicating significance at the 1%, 5%, and 10%, respectively.

### 5.4.3 Effect of Infrastructure Investment on Short-term and Long-term Government Borrowing in Africa

Here, the analysis of the effect of infrastructure investment on government borrowing in

Africa, dissected into short-term and long-term perspectives, yields nuanced insights, particularly when accounting for the Resource for Infrastructure (RFI) scheme's influence. In the short-term borrowing context (in Table 5.5), the effect of the investment amount is statistically insignificant, which contrasts with the significant negative influence of the RFI at the 5% level, as indicated by a coefficient of -0.0481. This suggests that RFI arrangements can reduce short-term debt ratios, countering concerns about negative repercussions and aligning with transformationalist perspectives on globalization benefits. This outcome is particularly significant as it highlights the potentially stabilizing effect of such investments on short-term financial obligations.

In terms of long-term borrowing in Table 5.6, findings demonstrate that infrastructure investment (coefficient of -0.0141) is negatively significant at the 5% level. This suggests a reduction in long-term external debt, reinforcing hyperglobalist and transformationalist interpretations of global integration's positive impacts. The consistency across long-term and short-term debt analyses underscores the strategic importance of Chinese infrastructure investment as a lever for economic stability in Africa.

Furthermore, the control variables provide further depth to these findings. For instance, African domestic investment's negative association with both short- and long-term borrowing, suggests that local capital formation is crucial in reducing reliance on external debt. Similarly, the negative significant effect of the real exchange rate on debt levels, indicates that currency valuation plays a key role in debt management. Legal origin also emerges as a significant factor, with its positive influence on reducing short-term debt, significant at the 1% level, highlighting the role of legal systems in economic governance

and debt sustainability.

However, the insignificance of the inverse Mills ratio in both analyses indicates a potential limitation in the two-stage model's effectiveness, suggesting that selection bias may not significantly impact the results. This aspect warrants careful consideration, as it may influence the interpretation of the link between China's OII and government borrowing. Despite this, the observed effects of China's OII on long-term and short-term government borrowing offer valuable insights, reinforcing the view that strategic investments can contribute to economic resilience in Africa, aligning with existing literature and challenging simplistic narratives around debt dynamics in the continent.

**Table 5.5 Effect of infrastructure investment on short-term government borrowing**

| | (1) | (2) |
|---|---|---|
| *Infrastructure Investment* | -0.0003 | |
| | (0.0040) | |
| *Resource for infrastructure* | | -0.0481** |
| | | (0.0192) |
| *GDP growth rate* | -0.0001 | 0.00096 |
| | (0.0010) | (0.00097) |
| *African domestic investment* | -0.0028*** | -0.0028*** |
| | (0.0009) | (0.0009) |
| *Interest rate* | 0.0005 | 0.0006 |
| | (0.0008) | (0.0008) |
| *Inflation rate* | 0.0009* | 0.0010* |
| | (0.0005) | (0.0005) |
| *Real Exchange rate* | -0.0229*** | -0.0230*** |
| | (0.0067) | (0.0067) |
| *Institutional quality* | -0.0296*** | -0.0338*** |
| | (0.0086) | (0.0090) |
| *Existing infrastructure* | 0.0195*** | 0.0198*** |
| | (0.0022) | (0.0023) |
| *Population growth* | 0.0126 | 0.0138 |
| | (0.0088) | (0.0091) |
| *Trade openness* | 0.00167** | 0.0017** |
| | (0.00066) | (0.0008) |
| *Legal origin* | 0.0768*** | 0.0738*** |
| | (0.0169) | (0.0162) |
| *Inverse mill ratio* | -0.0035 | -0.0047 |
| | (0.0100) | (0.0083) |
| Constant | 0.0234 | 0.0182 |
| | (0.0496) | (0.0460) |
| Observations | 720 | 720 |
| R-squared | 0.270 | 0.274 |

Note: The table presents the outcomes of the Heckman second stage regression analysis, focusing on the short-term debt ratio as the dependent variable. Both infrastructure investment and real exchange rate are log-transformed. Additionally, the Inverse Mills Ratio derived from the Probit regression is included. Year and country dummies are incorporated, with robust standard errors shown in parentheses. Definitions and measurements of variables are provided in Appendix. Statistical significance levels are denoted by ***, **, and * indicating significance at 1%, 5%, and 10%, respectively.

**Table 5.6 Effect of infrastructure investment on long-term government borrowing**

| | (1) | (2) |
|---|---|---|
| *Infrastructure investment* | -0.0141** | |
| | (0.0068) | |
| *Resource for infrastructure* | | -0.0405 |
| | | (0.0343) |
| *GDP growth rate* | -0.0059** | -0.0056** |
| | (0.0025) | (0.0025) |
| *African domestic investment* | -0.0022* | -0.0022* |
| | (0.0011) | (0.0011) |
| *Interest rate* | 0.0033*** | 0.0034*** |
| | (0.0011) | (0.0011) |
| *Inflation rate* | 0.0027* | 0.0028* |
| | (0.0015) | (0.0015) |
| *Real Exchange rate* | -0.0307*** | -0.0310*** |
| | (0.0108) | (0.0109) |
| *Institutional quality* | 0.0023 | 0.0002 |
| | (0.0227) | (0.0230) |
| *Existing infrastructure* | 0.0208*** | 0.0216*** |
| | (0.0037) | (0.0037) |
| *Population growth* | -0.0139 | -0.0122 |
| | (0.0102) | (0.0103) |
| *Trade openness* | 0.0008*** | 0.0008*** |
| | (0.0003) | (0.0003) |
| *Legal origin* | -0.0899*** | -0.0903*** |
| | (0.0216) | (0.0219) |
| *Inverse mill ratio* | 0.0025 | 0.0204 |
| | (0.0176) | (0.0149) |
| Constant | 0.5052*** | 0.4649*** |
| | (0.0859) | (0.0830) |
| Observations | 720 | 720 |
| R-squared | 0.210 | 0.208 |

Note: The table presents the outcomes of the Heckman second stage regression analysis, focusing on the long-term debt ratio as the dependent variable. Both infrastructure investment and real exchange rate are log-transformed. Additionally, the Inverse Mills Ratio derived from the Probit regression is included. Year and country dummies are incorporated, with robust standard errors shown in parentheses. Definitions and measurements of variables are provided in Appendix. Statistical significance levels are denoted by ***, **, and * indicating significance at 1%, 5%, and 10%, respectively.

### 5.4.4 Robustness Tests

To ensure the reliability of our findings, we verify our baseline results presented in Table 5.4, we use another variable, "Project Loans," as the primary explanatory variable. A project loan is a type of financial assistance representing the infrastructure project debt. This is obtained from the China-Africa Research Initiative database. The model is specified as follows:

$$GB_{it} = \beta_0 + \beta_1 Project\ loans_{it} + \beta_1 GDP_{it} + \beta_2 INQ_{it} + \beta_3 TO_{it} + \beta_4 LO_{it} + \beta_5 INF_{it} + \beta_6 ADV_{it} + \beta_7 INFL_{it} + \beta_8 POP_{it} + \beta_9 EXC_{it} + \beta_{10} INR_{it} + \beta_{11} IMR + \mu_i + \varepsilon_{it} \quad (3)$$

Notably, in Table 5.7, project loans exhibit a significant negative coefficient at the 5% level (-0.0219), indicating that these loans, like infrastructure investments, contribute to reducing the external debt ratio in African countries. This outcome suggests a broader narrative where Chinese financial interactions, whether through direct infrastructure investments or project loans, play a pivotal role in addressing Africa's infrastructure deficit. Efficient utilization of these funds, as the results imply, could lead to enhanced revenue generation and a reduced reliance on external borrowing, presenting a beneficial scenario for the continent's economic landscape.

Furthermore, the analysis reaffirms the significance of various economic and institutional factors in shaping government borrowing dynamics. For instance, GDP growth rate and African domestic investment both show significant negative associations with government borrowing, reinforcing the idea that economic expansion and internal capital formation are crucial for reducing debt dependencies. Conversely, variables such as interest rates and inflation rates are positively correlated with borrowing, highlighting the challenges posed by macroeconomic conditions. However, the real exchange rate's

significant negative impact suggests that currency strength can mitigate debt levels, emphasizing the multifaceted influences on debt sustainability in Africa. Critically, the robustness test also underscores the efficacy of the Heckman selection model, evidenced by the lambda's significant negative impact at the 1% level. This indicates that accounting for selection bias is essential in accurately capturing the effects of Chinese project loans on African external debt ratios. Overall, the robustness checks not only validate the initial findings but also broaden the understanding of China-Africa financial interactions, illustrating their potential to aid positively to Africa's economic advancement and debt management strategies.

**Table 5.7 Robustness test: Effect of project loan on government borrowing of countries in Africa.**

| | (1) |
|---|---|
| *Project loans* | -0.0219** |
| | (0.0106) |
| *GDP growth rate* | -0.0148*** |
| | (0.0041) |
| *African domestic investment* | -0.0084*** |
| | (0.0018) |
| *Interest rate* | 0.0047*** |
| | (0.0015) |
| *Inflation rate* | 0.0031** |
| | (0.0012) |
| *Real Exchange rate* | -0.0585*** |
| | (0.0152) |
| *Institutional quality* | -0.0063 |
| | (0.0316) |
| *Existing infrastructure* | 0.0552*** |
| | (0.0087) |
| *Population growth* | -0.0262 |
| | (0.0166) |
| *Trade openness* | 0.0014*** |
| | (0.0005) |
| *Legal origin* | -0.0451 |
| | (0.0319) |
| *Inverse mill ratio* | -0.2311*** |
| | (0.0680) |
| Constant | 0.8677*** |
| | (0.1481) |
| Observations | 720 |
| R-squared | 0.271 |

Note: In this table, the Heckman second stage regression outcomes are presented, focusing on the external debt ratio as the dependent variable. Both project loan and real exchange rate variables are logarithmically transformed. The Lambda derived from Probit regression is incorporated. Year and country dummy variables are included, and robust standard errors are reported in parentheses. Please refer to Appendix for the definitions and measurements of the variables. Statistical significance levels are denoted by ***, **, and *, representing significance at 1%, 5%, and 10%, respectively.

To address the limitations of the Heckman model, specifically the insignificance of the Lambda, a Logistic Regression (LR) analysis was conducted as a robustness check. This approach is particularly apt for our investigation given its suitability for classification studies, as highlighted in the literature by Brownlee (2016), Goto et al., (2018), and Barboza et al., (2017). The LR model, a prevalent machine learning algorithm for binary classification, offers enhanced prediction accuracy for our examination of the external debt ratio-to-GDP in African countries. This ratio was binary classified to reflect the sustainability of the debt threshold set by the AMCP at 60%, distinguishing between scenarios indicative of a debt trap and those that are not. The specification is as follows:

$$\ln P(y=1)/P(y=0)_{it} = \beta_0 + \beta_1 Interaction_{it} + \beta_1 GDP_{it} + \beta_2 INQ_{it} + \beta_3 TO_{it} + \beta_4 LO_{it} + \beta_5 INF_{it} + \beta_6 ADV_{it} + \beta_7 INFL_{it} + \beta_8 POP_{it} + \beta_9 EXC_{it} + \beta_{10} INR_{it} + \beta_{11} IMR + \mu_i + \varepsilon_{it} \quad (4)$$

The logistic regression results, as indicated in Table 5.8, revealed that the coefficients for infrastructure investment, Resource for Infrastructure (RFI), and project loans are significantly negative, with respective odds ratios of 0.706, 0.219, and 0.770. These values, being less than one, suggest a low probability of a debt trap crisis resulting from China-Africa financial engagements. Notably, the starkly significant effect and the low odds ratio for RFI (-1.5146 at the 10% level) highlight its impactful role in mitigating total government borrowing, including both short-term and long-term debts. These results corroborate the negative impacts on African government borrowing observed in the Heckman model, thus reinforcing the narrative that China-Africa interactions through infrastructure projects exert a downward pressure on African government borrowing. The control variables' outcomes align with those from the Heckman model, validating the robustness of the findings across different analytical approaches.

Overall, the model performance is acceptable, as the Wald Chi-square test shows. The Wald test of the model is highly significant, showing that explanatory variables' coefficients contribute significantly to the model. Likewise, the reported McFadden pseudo-R-squared obtained indicates a reasonably good model fit. In line with that, McFadden (1977) asserts that the rule of thumb for a good McFadden's pseudo-R-squared is usually set between 0.2-0.4.

**Table 5.8 Robustness test: Effect of infrastructure investment on government borrowing of countries in Africa using Machine Learning Algorithm**

| | (1) | (2) | (3) |
|---|---|---|---|
| *Infrastructure investment* | -0.3485*** | | |
| | (0.1155) | | |
| *Resource for infrastructure* | | -1.5146* | |
| | | (0.8705) | |
| *Project loans* | | | -0.2595** |
| | | | (0.1226) |
| *GDP growth rate* | -0.0928** | -0.0968** | -0.0993** |
| | (0.0416) | (0.0411) | (0.0418) |
| *African domestic investment* | -0.0520*** | -0.0536*** | -0.0534*** |
| | (0.0160) | (0.0160) | (0.0158) |
| *Interest rate* | 0.0313*** | 0.0329*** | 0.0285** |
| | (0.0120) | (0.0119) | (0.0117) |
| *Inflation rate* | 0.0842*** | 0.0858*** | 0.0827*** |
| | (0.0177) | (0.0192) | (0.0189) |
| *Real Exchange rate* | -0.3391** | -0.3393** | -0.3170** |
| | (0.1470) | (0.1491) | (0.1462) |
| *Institutional quality* | -0.5337** | -0.5266** | -0.4460* |
| | (0.2444) | (0.2562) | (0.2392) |
| *Existing infrastructure* | 0.9739*** | 0.8983*** | 0.8810*** |
| | (0.1588) | (0.1538) | (0.1528) |
| *Population growth* | 0.0453 | 0.0097 | -0.0144 |
| | (0.1360) | (0.1448) | (0.1399) |
| *Trade openness* | 0.0067** | 0.0083*** | 0.0082*** |
| | (0.0027) | (0.0028) | (0.0030) |
| *Legal origin* | -0.7033** | -0.8857** | -0.8248** |
| | (0.3251) | (0.3525) | (0.3492) |
| Constant | -0.3226 | -0.3678 | -0.1353 |
| | (0.6626) | (0.7235) | (0.6639) |
| Pseudo $R^2$ | 0.322 | 0.315 | 0.313 |
| Wald $X^2$ | $123.46^{***}$ | $135.87^{***}$ | $121.68^{***}$ |
| Observations | 720 | 720 | 720 |

Note: This table presents the results of the Logit model estimation, where the dependent variable is dichotomized into a binary form: 1 indicates a debt trap, while 0 signifies no debt trap. Infrastructure investment, project loans, and real exchange rates are logarithmically transformed. Year and country dummies are incorporated, with robust standard errors reported in parentheses. The Wald test Chi-squared and pseudo-R-squared values assess the overall model performance. Please refer to Appendix for variable definitions and measurements. Statistical significance levels are denoted by ***, **, and * representing 1%, 5%, and 10%, respectively.

**Table 5.9 Odd ratio of the infrastructure interaction**

| Variable | Odd ratio |
|---|---|
| Infrastructure investment | 0.706 |
| RFI | 0.219 |
| Project loans | 0.770 |

Note: Odd ratio is as [Ln P(y=1)/ P(y=0)], if greater than or equals to one implies debt trap,otherwise no-debt trap crisis (less than one).

## 5.5 Discussion and Conclusion

Our study critically examines the effect of Chinese-African infrastructure project interactions on the debt dynamics of government in Africa, focusing on whether such engagements precipitate a debt crisis. The analysis employs various proxies to capture the essence of China-Africa interactions, including a dummy variable indicating receipt of Chinese infrastructure investment and another representing engagements in resource-for-infrastructure (RFI) deals. The empirical findings lead to several key conclusions: first, China-Africa infrastructure interactions do not inherently lead to a debt trap in African countries, aligning with the optimistic perspectives of hyperglobalists and transformationalists. Second, our analysis, employing both Heckman and machine learning models, reveals that RFI arrangements contribute to a reduction in both short-term and total government borrowing, contradicting fears of negative debt outcomes. Additionally, the evidence suggests that such interactions do not exacerbate long-term debt burdens, supporting the notion that Chinese investments may be beneficial for African fiscal health.

The analysis identifies several factors, including GDP growth rate, domestic investment, and macroeconomic indicators like inflation and interest rates, that mediate

the relationship between China-Africa interactions and government borrowing. The overarching implication is that Chinese infrastructure investments can exert a positive influence on African economies by potentially reducing government borrowing needs and fostering sustainable economic development.

In terms of policy implications, while our findings underscore the generally positive fiscal impact of Chinese investments, they also highlight the importance of prudent fiscal management and policy formulation regarding foreign financial inflows. Policymakers should consider revising fiscal policies to better govern these flows, possibly moving towards more grant-based assistance or concessionary lending terms. Attention should also be given to the internal factors identified as influencing government borrowing, advocating for policies that promote private and public savings to mitigate budget deficits and debt burdens.

The study further illuminates the complex dynamics surrounding commodity-based loans, suggesting that, contrary to some critical views, RFI engagements may alleviate rather than exacerbate government debt levels. This challenges the narrative of an impending resource curse from Chinese investments but also cautions African policymakers to safeguard against exploitative practices in natural resource exploitation.

It is important to note, some of our policy discussions, especially around broader economic policies and natural resource exploitation safeguards, extend beyond the direct findings of our analysis and are suggested as areas for further investigation or consideration. Our analysis is limited by data constraints, particularly regarding domestic debt sustainability, suggesting a potential avenue for future studies to deepen the understanding of the China-Africa fiscal interaction paradigm.

# CHAPTER 6
# CONCLUSION

## 6.1 Introduction

This thesis assesses the impact of Chinese outward infrastructure investment (OII) in Africa. This thesis is analysed under three themes. First, we investigate the impact of Chinese OII on the performance of African- listed firms, emphasising the productivity spillover effect and signaling effect. Second, we examine the influence of China's OII on the exports of industries and countries in Africa, specifically to assess the postulation of MNEs and new trade theories on complementary and substitutability effects. Third, we explore the debt trap paradigm of China's OII in Africa. To be precise, we assess whether the interaction via infrastructure projects affects the debt sustainability of countries in Africa.

## 6.2 Summary of Main Findings

Our findings present a nuanced understanding of China's OII in Africa, affirming its value-oriented nature and diverse impacts across different sectors and economic indicators. In chapter 3, we observed that China's OII positively affects the stock market valuation of African-listed firms without necessarily enhancing traditional accounting performance metrics. This underscores the market's perception of such collaborations as indicative of future growth, even in the absence of immediate productivity spillovers. The involvement of Chinese entities serves as a marker of credibility, attracting investor interest despite limited evidence of direct economic benefits in terms of productivity.

In chapter 4, our analysis indicates that Chinese infrastructure investments have a complementary relationship with exports from Africa's primary industries, supporting the resource-seeking motive of Chinese SOEs. Conversely, in non-primary sectors, such investments show a tendency to substitute local production for exports, suggesting a focus on serving domestic markets within African countries. These findings articulate the diverse objectives of Chinese investments, necessitating differentiated policy approaches.

In Chapter 5, contrary to concerns of a potential debt trap, our study concludes that China-Africa infrastructure interactions do not exacerbate the debt burden of African countries. Instead, engagements, particularly those structured as resource-for-infrastructure (RFI) deals, appear to have a mitigating effect on government debt levels.

## 6.3 Implications

This thesis offers recommendations for academic institutions, African businesses, and regulatory bodies. In chapter 3, our study underscores the importance of leveraging Chinese OII to enhance stock market activities and investor confidence while ensuring vigilant oversight to prevent speculative bubbles. Moreover, strengthening African businesses' ability to absorb and benefit from foreign investments is essential. This indicates a requirement for policy measures to foster innovation and skill enhancement to harness these investments' potential fully.

In light of the complementary effects observed in primary sectors in Chapter 4, African countries can engage more strategically with Chinese SOEs to boost exports and economic development. However, safeguard measures are necessary to protect local industries and ensure sustainable resource management.

The positive impact of Chinese investments on debt sustainability in chapter 5 calls for continued prudent fiscal management by African governments. Policies should be aimed at maintaining healthy public savings rates and managing external financial inflows judiciously.

## 6.4 Limitations and Directions for Future Research

Our analysis offers a detailed exploration of Chinese OII in Africa, yet it is constrained by certain data limitations that present avenues for future research. In Chapter 3, our investigation primarily encompasses listed African firms, leaving out a significant segment of non-listed entities and government agencies actively engaged in China's OII projects. Incorporating these actors into future studies could provide a more holistic view of the investment's impact and reveal additional insights into the strategic motivations and outcomes of these projects, especially as data availability improves.

Additionally, the lack of access to granular data on variables such as research and development intensity, firm size, and labour force characteristics limited our ability to fully dissect the sector-specific impacts of Chinese OII in Chapter 4. This gap suggests that further examination into how these investments influence diverse industry parameters could unveil determinants of success and areas for policy optimization.

In Chapter 5, the challenge of accessing comprehensive data on domestic debt sustainability curtailed our analysis of public debt implications stemming from China-Africa economic interactions. This gap underscores the potential for future research to delve into the nuances of debt dynamics, offering valuable contributions to the discourse on financial stability and sustainable borrowing practices within the region.

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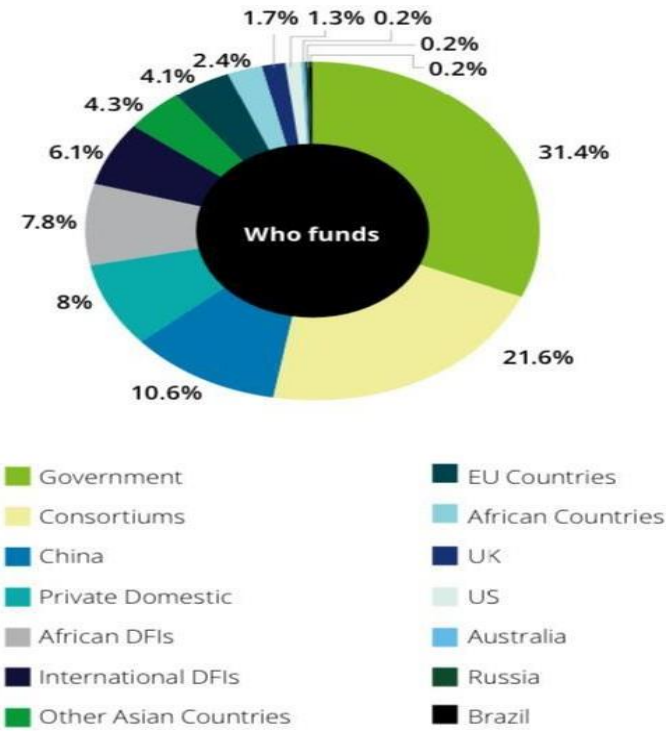
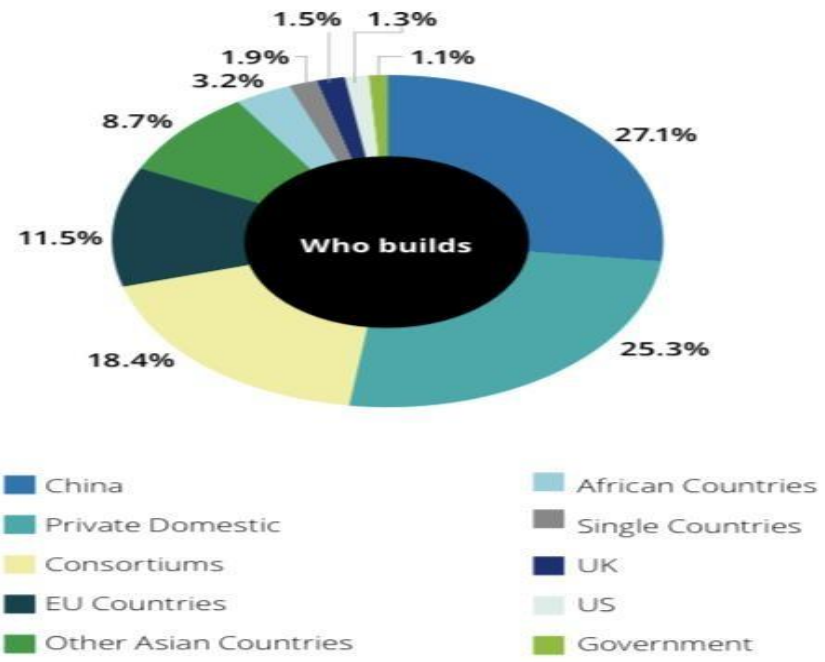
# APPENDIX

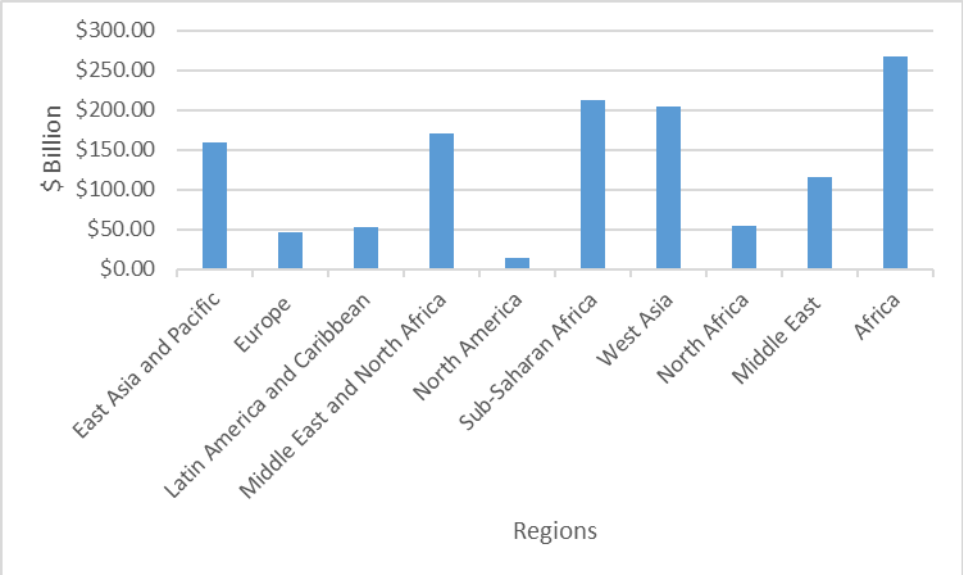
**Figure 1 Infrastructure projects activity in Africa**





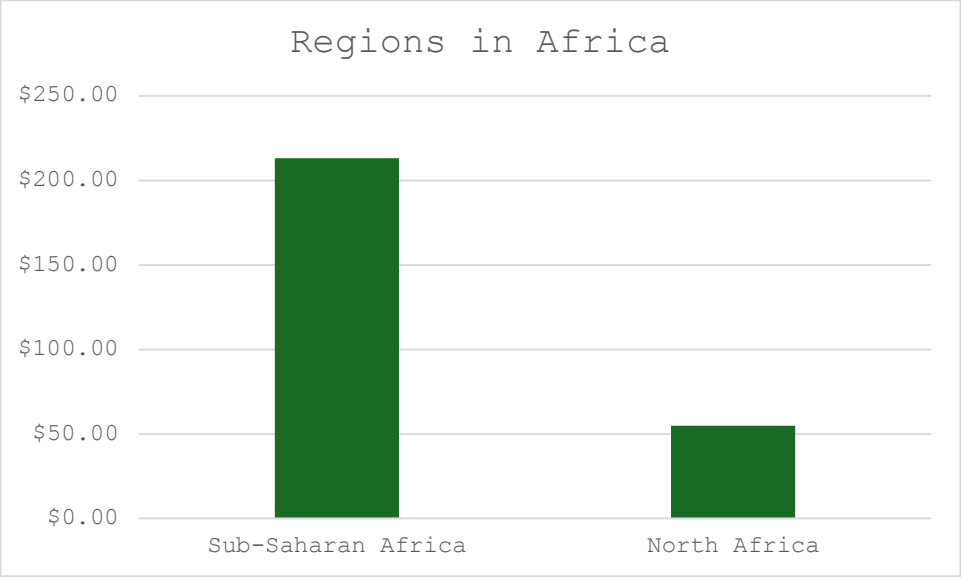

Source: Deloitte African Construction Trends, 2021.

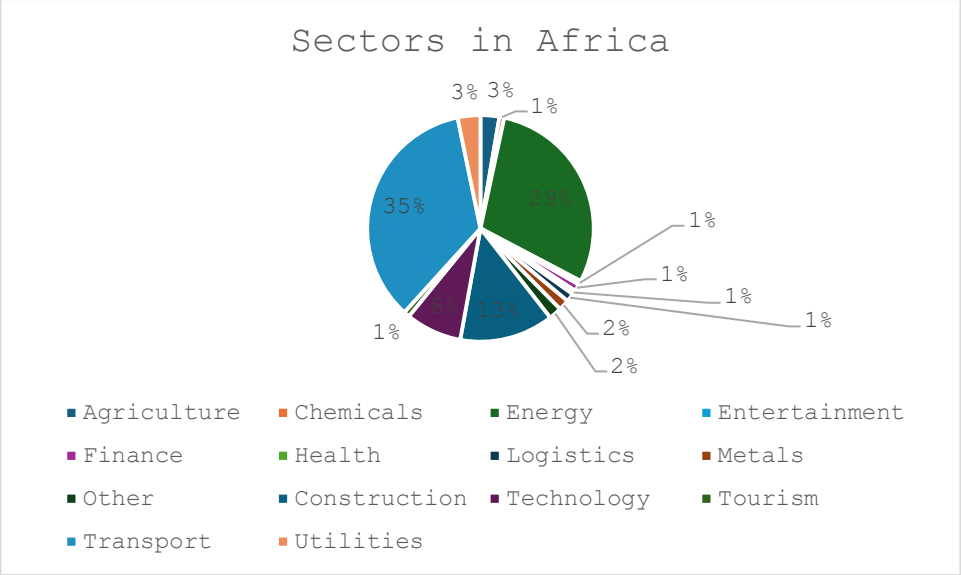
**Figure 2 Distribution of China's OII across regions of the World**

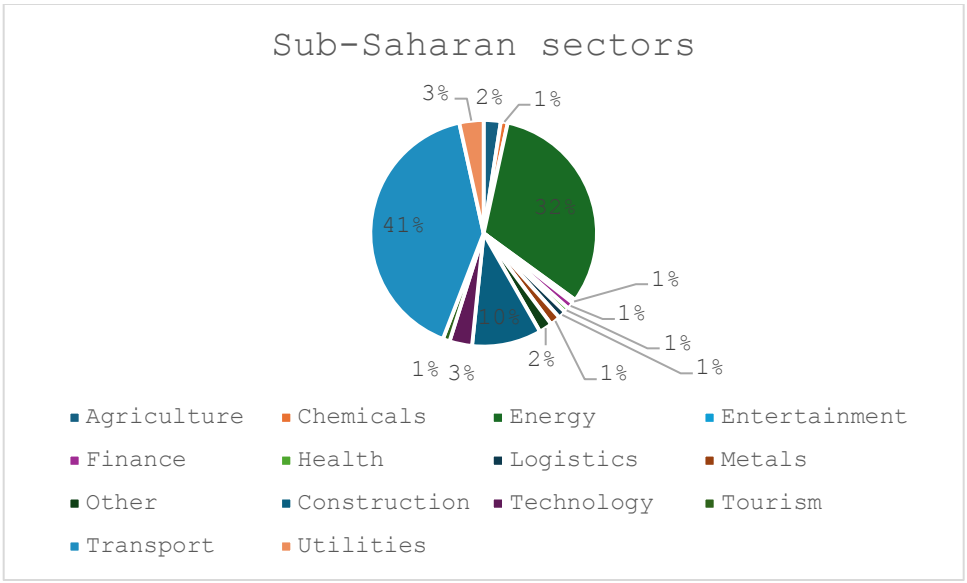


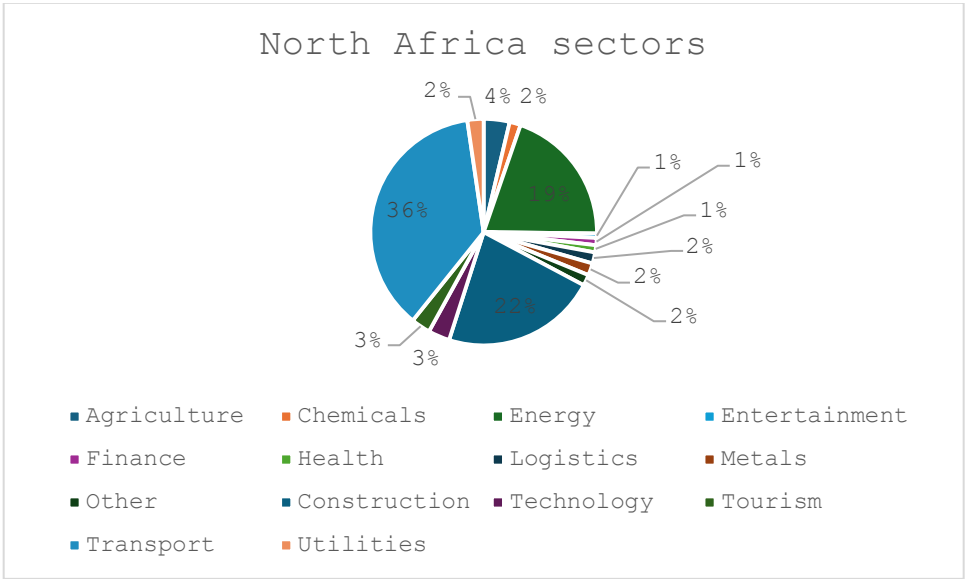

Source: China Global Investment Tracker, 2021

**Figure 3 Distribution of China's OII across regions and sectors in Africa**



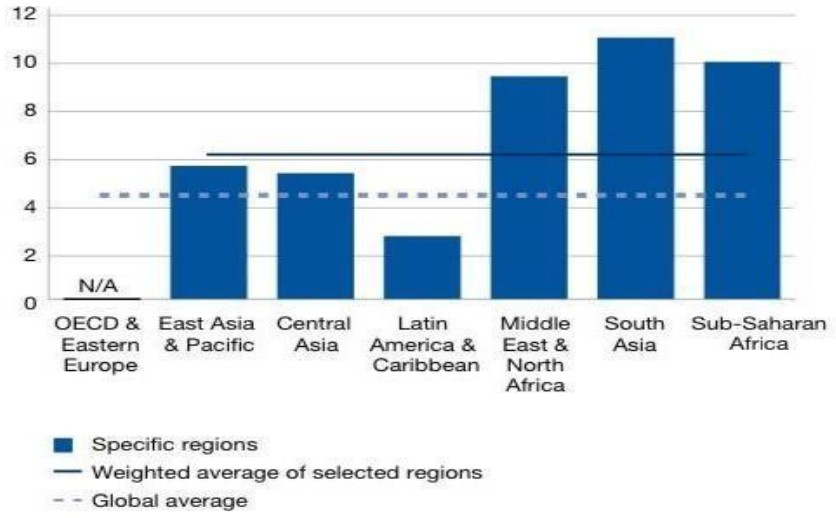






Source: China Global Investment Tracker, 2021

**Figure 4 Annual infrastructure investment and maintenance needs (%GDP)**



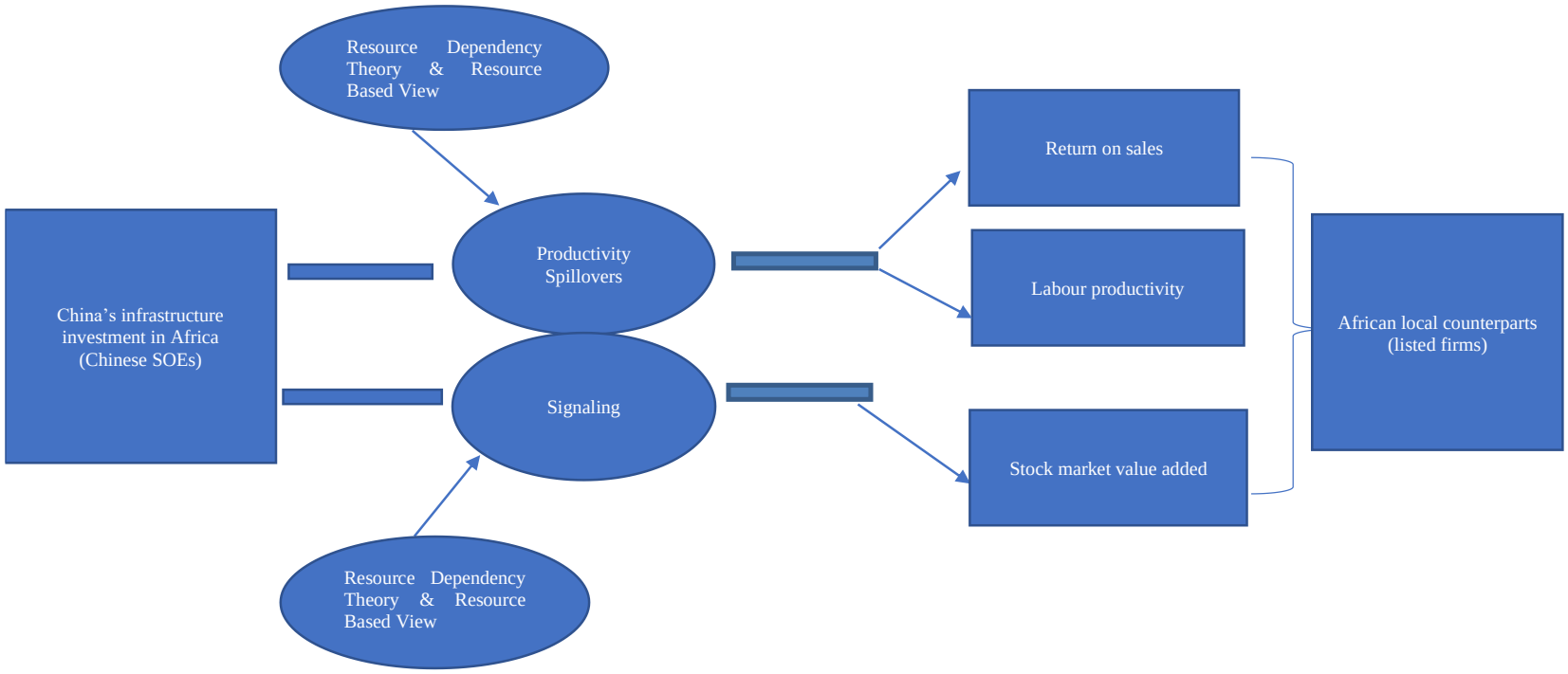

Source: World Economic Forum, 2012

# Chapter 3

**Description of variables and data sources**

| Denotation | Variable | Measurement of variables | Data source |
|---|---|---|---|
| MVA | Market value added | Ratio of market value of the firm minus book value of the firm to total assets | *Thomson DataStream* |
| ROA | Return on assets | Ratio of operating profit to total assets | *Thomson DataStream* |
| LP | Labour productivity | Ratio of firm net income to number of employees | *Thomson DataStream* |
| Counterpart | Counterpart | A dummy variable that takes the value of one if the African firm is the local counterpart of the infrastructure project, otherwise it is zero | *China Global Investment Tracker* |
| CD | Chinese director | A dummy variable which takes the value of one if a Chinese director is present on the Board of listed African firms that are involved in infrastructure project, otherwise zero | *Audited Annual Report* |
| SHARE | Chinese ownership | A dummy variable which takes the value of one if a Chinese firm hold more than 50% of the listed Africa firms that are involved in infrastructure project, otherwise it is zero | *Audited Annual report* |
| INV | Infrastructure investment | The amount of Chinese investment in the infrastructure project in the current year scaled by total Chinese infrastructure investments in Africa in the current year | *China Global Investment Tracker* |
| LEV | Leverage | Ratio of total debts to total assets. | *Thomson DataStream* |
| SIZE | Firm size | Natural logarithm of total assets. | *Thomson DataStream* |
| RD | Research expenditure | Ratio of research and development expenditure to total sales | *African Financials Database* |
| SG | Sales growth | Annual growth rate of sales | *Thomson DataStream* |
| CFLOW | Cashflow | Ratio of net profit plus depreciation to total assets. | *Thomson DataStream* |
| EXP | Export-orientation | A dummy variable which takes the value of one if an African firm engages in exportation of goods and services, otherwise it is zero | *African Financials Database and audited annual report* |
| GDP | Gross domestic product (GDP) per capita | Natural logarithm of host country GDP per capita | *World Bank Development Indicator Database* |
| PRI | Primary industry | Dummy variable that takes the value of 1 if the firm belongs to the primary industry and 0 for manufacturing or service industry. | *China Global Investment Tracker and audited annual report* |
| INST | Institutional distance | The difference between economic freedom index of China and host country. | *Wall Street Journal and Heritage foundation database* |
| AR | Abnormal return | Actual return of the firm minus the expected Return | *Thomson DataStream and investing.com* |

**Conceptual framework of Interaction and firm performance**



**Variance inflation factor**

| | VIF | 1/VIF |
|---|---|---|
| *Counterpart* | 1.356 | 0.738 |
| *GDP per capita* | 1.221 | 0.819 |
| *Export orientation* | 1.180 | 0.847 |
| *Institutional distance* | 1.174 | 0.852 |
| *Chinese ownership* | 1.171 | 0.854 |
| *Firm size* | 1.151 | 0.869 |
| *Chinese director* | 1.151 | 0.869 |
| *Infrastructure investment* | 1.148 | 0.871 |
| *Cashflow* | 1.100 | 0.909 |
| *Primary* | 1.095 | 0.913 |
| *Sales growth* | 1.090 | 0.917 |
| *Leverage* | 1.020 | 0.980 |
| *Research expenditure* | 1.010 | 0.990 |
| *Mean VIF* | 1.144 | . |

**Structure of sample firms**

| Types of Firms | Firms that are involved in China's infrastructure projects | Firms that are not involved in China's infrastructure projects | Total |
|---|---|---|---|
| African listed firms | 51 | 452 | 503 |

**Industry distribution of sample firms**

| | Primary industry | | Manufacturing industry | | Service industry | | Total | |
|---|---|---|---|---|---|---|---|---|
| | All firms | Interactive firms | All firms | Interactive firms | All firms | Interactive firms | All firms | Interactive firms |
| African listed firms | 128 | 28 | 194 | 8 | 181 | 15 | 503 | 51 |

# Chapter 4

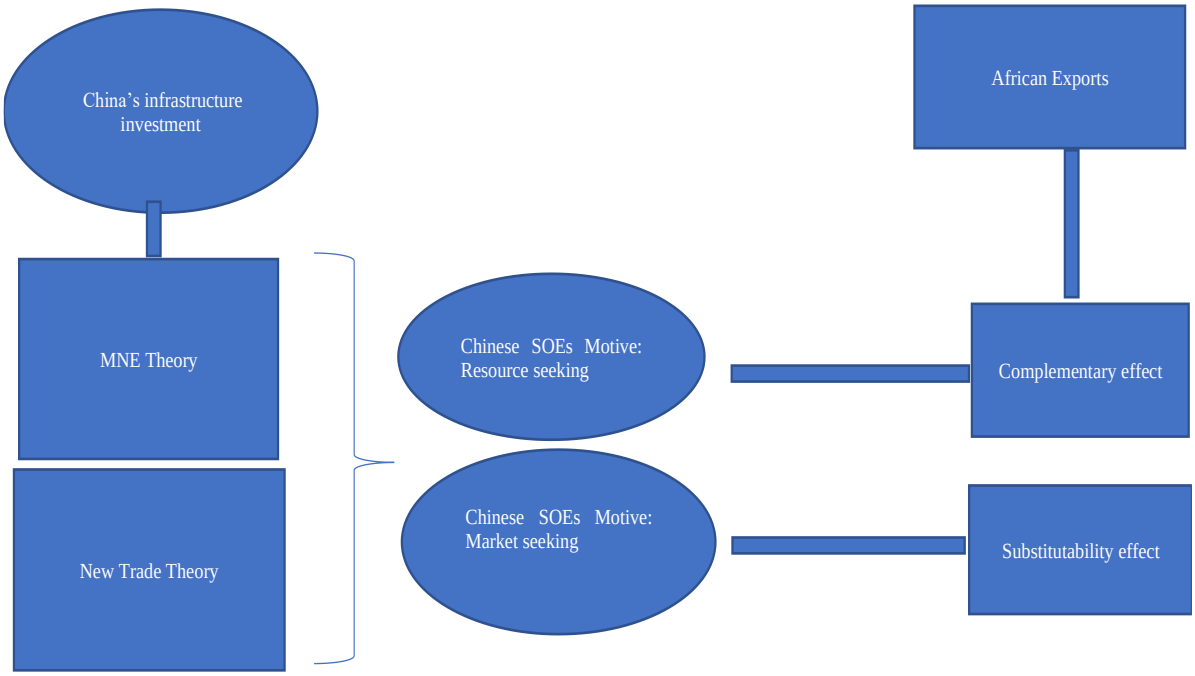
**Description of variables and data sources**

| Denotation | Variable | Measurement of variables | Data source |
|---|---|---|---|
| EXP | Export to China | African countries' exports to China in US dollars divided by GDP of the host country | *United Nations Comtrade, IMF Direction of Trade Statistics, World Trade Organisation* |
| INV | Infrastructure investment | The amount of Chinese investment in the infrastructure project to African countries divided by GDP | *China Global Investment Tracker* |
| RE | Recipient | A dummy variable which takes the value of one if a country/industry in Africa received China's infrastructure project investment, otherwise it is zero | *China Global Investment Tracker* |
| R4I | Resource for infrastructure deal | A dummy variable that takes the value of one if the African country is involved in RFI deals, otherwise it is zero. | *China Global Investment Tracker* |
| GDP | Gross domestic product (GDP) per capita | Natural logarithm of host country GDP per capita. | *World Bank Development Indicator Database* |
| INFLA | Inflation rate | Annual growth of the changes in the general price level of the host country. | *World Bank Development Indicator Database* |
| INQ | Institutional quality | This is arithmetic mean of six governance indicators. | *World Governance Indicator Database* |
| NR | Natural resources | Ratio of host country total natural resources rent to GDP. | *World Bank Development Indicator Database* |
| TO | Trade openness | Ratio of trade (export plus import) to China divided by host country GDP | *World Bank Development Indicator Database* |
| DIST | Distance | Geographical distance between the host country's capital and China's capital city. | *CEPII* |
| LO | Legal origin | Dichotomous variable which takes the value of 1 if listed African firm is in country that is practicing British common law, otherwise 0 for French civil law. | LaPorta et al. (1999) |
| INF | Existing Infrastructure | Broadband subscriptions per 100 people. | *World Bank Development Indicator Database* |
| POP | Population | The number of population age between 15-64 | *World Bank Development Indicator Database* |
| ADINV | African domestic investment | Ratio of African countries' gross capital formation to GDP. | *World Bank Development Indicator Database* |
| DEBT | Debt to China | The amount of African's debt to China. | *China-Africa Research Initiative Database* |

**Variance Inflator Factor**

| | VIF | 1/VIF |
|---|---|---|
| *Institutional quality* | 2.194 | 0.456 |
| *Natural resource* | 2.084 | 0.480 |
| *Gross domestic product* | 2.023 | 0.494 |
| *Population* | 1.628 | 0.614 |
| *Distance* | 1.535 | 0.651 |
| *Trade openness* | 1.450 | 0.690 |
| *African domestic investment* | 1.382 | 0.724 |
| *Inflation rate* | 1.160 | 0.862 |
| *Infrastructure investment* | 1.082 | 0.925 |
| Mean VIF | 1.767 | . |

**Conceptual framework of Interaction and exports**



# Chapter 5

**Description of variables and data sources**

| Denotation | Variable | Measurement of variables | Data source |
|---|---|---|---|
| GB | Government borrowing | This is bilateral external debt to China (including short-term and long-term debt) to GDP of countryunder study. | *International Debt Statistics Database* |
| INV | Infrastructure investment | The amount of China's infrastructure investment received by each African country. | *China Global Investment Tracker* |
| RE | Recipient | A dummy variable which takes the value of one if a country in Africa received China's infrastructure project investment, otherwise, it is zero | *China Global Investment Tracker* |
| RFI | Resource for infrastructure deal | A dummy variable that takes the value of one if the African country is involved in RFI deals, otherwise it is zero. | *China -Africa Research Initiative* |
| GDP | Gross domestic product growth rate | Rate of growth of host country GDP | *WorldBank Development Indicator Database* |
| ECX | Exchange rate | Real exchange rate of the host country. | *WorldBank Development Indicator Database* |
| INQ | Institutional quality | This is arithmetic mean of six governance indicators. | *WorldBank Development Indicator Database* |
| NR | Natural resources | Ratio of host country total natural resources rent to GDP. | *WorldBank Development Indicator Database* |
| TO | Trade openness | Ratio of trade (export plus import) to China divided by host country GDP | *WorldBank Development Indicator Database* |
| INR | Interest rate | This rate of return on investment of country under study. | *WorldBank Development Indicator Database* |
| LO | Legal origin | Dichotomous variable which takes the value of 1 if listed African firm is in country that is practicing British common law, otherwise 0 for French civil law. | LaPorta et al. (1999) |
| INF | Existing Infrastructure | Broadband subscriptions per 100 people. | *World Bank Development Indicator Database* |
| POP | Population growth | Growth rate of the population | *World Bank Development Indicator Database* |
| ADINV | African domestic investment | Ratio of African countries' gross capital formation to GDP. | *World Bank Development Indicator Database* |
| INFL | Inflation | Rate of change of consumer price index | *World Bank Development Indicator Database* |
| PR | Project loans | The amount of African's debt to China. | *China-Africa Research Initiative Database* |

**Variance Inflator Factor**

| | VIF | 1/VIF |
|---|---|---|
| Existing infrastructure | 1.58 | 0.63 |
| African domestic investment | 1.52 | 0.66 |
| Population growth | 1.44 | 0.69 |
| Institutional quality | 1.42 | 0.70 |
| Project Loan | 1.37 | 0.73 |
| Recipient | 1.32 | 0.76 |
| Resource for infrastructure | 1.29 | 0.77 |
| Trade openness | 1.28 | 0.78 |
| Legal origin | 1.24 | 0.81 |
| Inflation rate | 1.16 | 0.86 |
| Interest rate | 1.15 | 0.87 |
| GDP growth rate | 1.11 | 0.90 |
| Exchange rate | 1.09 | 0.92 |
| Mean VIF | 1.30 | . |

**Conceptual framework of Interaction and government borrowing**